Aviation Week and Space Technology

May 29, 1961

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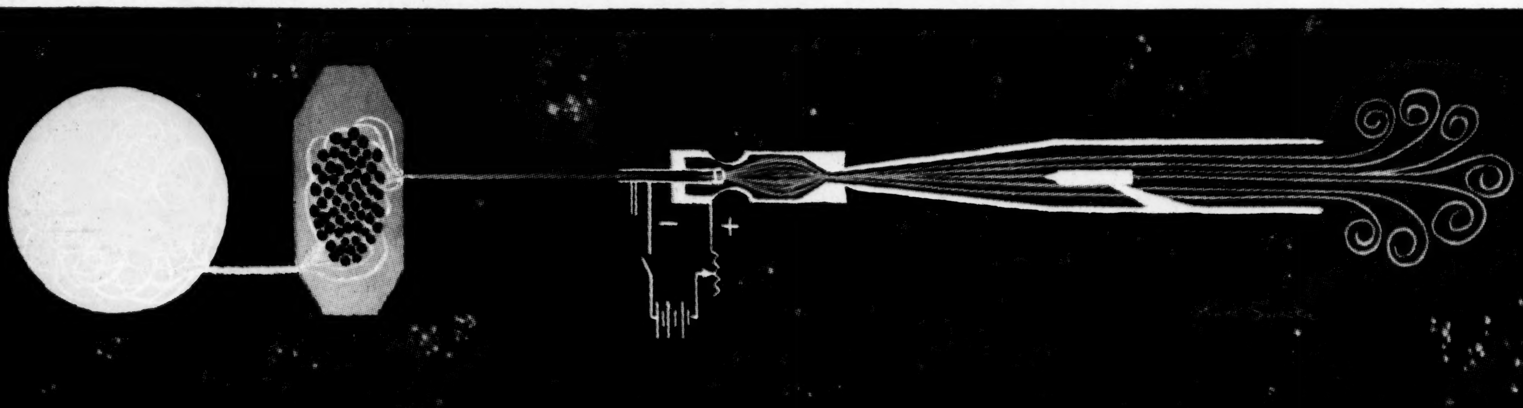

AVIATION CALENDAR

June 6-7—Air Transport Section, National Safety Council, Executive Committee Meeting, Lambert Field, St. Louis, Mo.

June 6-8—Armed Forces Communications & Electronics Assn. Convention, Sheraton-Park/Shoreham Hotels, Washington.

June 6-8—International Instrument-Automation Conference & Exhibit, Instrument Society of America, Royal York Hotel, Toronto, Canada.

June 6-11—Golden Anniversary of Naval Aviation, Pensacola, Fla.

June 11-14—Summer Annual Meeting, American Society of Mechanical Engineers, Statler-Hilton Hotel, Los Angeles.

June 12-13—Third National Radio Frequency Interference Symposium, Institute of Radio Engineers, Sheraton Park Hotel, Washington, D. C.

June 13-15—37th Meeting, Aviation Distributors and Manufacturers Assn., Dennis Hotel, Atlantic City, N. J.

June 13-16—National Joint Meeting, Institute of the Aerospace Sciences and American Rocket Society, Ambassador Hotel, Los Angeles, Calif.

June 14-15—Fifth Annual Conference, Product Engineering and Production, Institute of Radio Engineers, Sheraton Hotel, Philadelphia, Pa.

June 18-23—Summer General Meeting, American Institute of Electrical Engineers, Cornell University, Ithaca, N. Y.

June 19-21—Space Flight and Re-entry Trajectories Symposium, International Astronautical Federation's International Academy of Astronautics, Paris, France.

June 19-21—Institute of Navigation—USAF Symposium on Supersonic Air Transport

(*Continued on page 6*)

AVIATION WEEK and Space Technology

May 29, 1961
Vol. 74, No. 22

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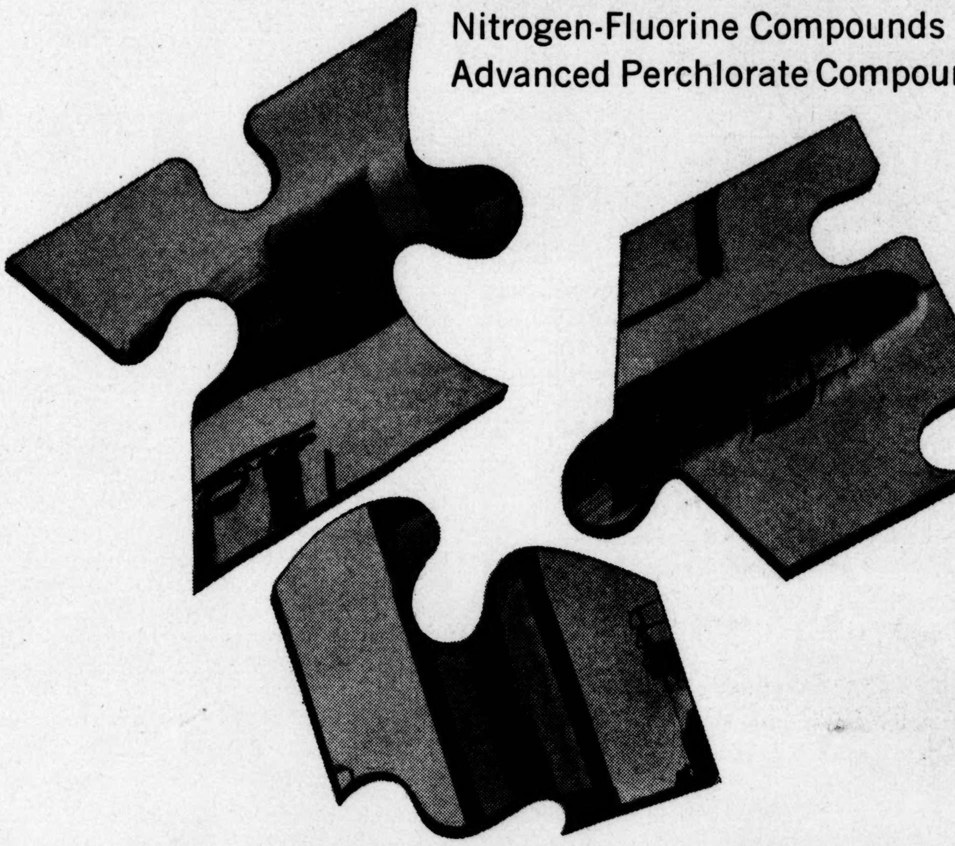

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AVIATION CALENDAR

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Navigation, Western Hills Hotel, Ft. Worth, Tex.

June 22-23—Eighth Annual Symposium on Computers and Data Processing, Denver Research Institute, Elkhorn Lodge, Estes Park, Colo.

June 24-27—First Reunion of World War I Overseas Flyers, Air Force Museum, Wright-Patterson AFB, Dayton, Ohio.

June 26-28—Fifth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.

June 26-28—European Symposium on Space Technology, British Interplanetary Society, London, England.

June 26-30—Special Technical Conference, American Institute of Electrical Engineers' Aerospace Transportation Committee, Benjamin Franklin Hotel, Philadelphia.

June 27-29—International Symposium on Analytical Astrodynamics, Santa Barbara, Calif. (Contact: Capt. J. L. Gilbert, Air Force Office of Scientific Research, Washington 25, D. C.)

June 28-30—Joint Automatic Control Conference, University of Colorado, Boulder.

June 28-July 1—Annual Meeting, Institute of Navigation, Williamsburg Inn, Williamsburg, Va.

July 17—Air Force Contract Aviation Services Symposium, National Aeronautical Services Assn., Hotel Washington, Washington, D. C.

July 20-21—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Grove Park Inn, Asheville, N. C.

July 24-26—Air Traffic Control Facilities Symposium, Electronic Maintenance Engineering Assn., Mayflower Hotel, Washington, D. C.

July 25-Aug. 10—International Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.

Aug. 1-3—Fourth Western Regional Meeting, American Astronautical Society, Sheraton-Palace Hotel, San Francisco, Calif.

Aug. 7-9—Guidance and Navigation Conference, American Rocket Society, Stanford University, Palo Alto, Calif.

Aug. 15-17—Cryogenic Engineering Conference, University of Michigan, Ann Arbor, Mich.

Aug. 16-18—International Hypersonics Conference, American Rocket Society, Massachusetts Institute of Technology, Cambridge, Mass.

Aug. 22-25—Western Electronic Show and Convention, Cow Palace, San Francisco.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 4-14—Eighth Anglo-American Conference, Institute of the Aerospace Sciences, London, England.

Sept. 6-8—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

Sept. 10-12—National Convention, National Aeronautic Assn., Westbury, N. Y.

Oct. 2-7—12th International Astronautical Congress, Washington, D. C.

Oct. 9-15—American Rocket Society's 16th Annual Meeting & Space Flight Report to the Nation, Coliseum, New York, N. Y.

May 29, 1961

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European Aircraft Take Spotlight at Paris Show.... 22

▶ Fourteen nations display over 90 aircraft, helicopter types; Europeans show wide range of military, civil and general aviation models.

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▶ Airline aims at faster check-in and baggage handling, stresses on-time departures and in-flight service.

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▶ Addition of high lift devices, modified controls and slightly higher thrust also allows operation at increased gross weights.

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COVER: Dassault's two-place delta-wing Mirage IV bomber is scheduled to join France's nuclear strike force beginning in 1963. Fifty of the aircraft have been ordered at a total cost of $200 million. The entire force is expected to be operational by 1965. The sole prototype, shown on the cover, has been flying since mid-1959. The first of three pre-production Mirage IVs is scheduled to fly by the end of this year. The bomber is powered by two Snecma Atar 9 afterburning turbojets delivering about 13,350 lb. thrust. The Mirage IV is designed to carry a nuclear payload 2,200 mi. at up to Mach 2.2.

PICTURE CREDITS

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EDITORIAL

The Challenge Must Be Met

There is increasing evidence lately that the Kennedy Administration is beginning to recognize the tremendous impact of technology on the tide of our times and is preparing to face fully the responsibility required by political leadership to make U.S. technology the keen cutting edge of an effective national and international policy.

President Kennedy observed earlier in his inaugural address that ". . . man holds in his mortal hands the power to abolish all forms of human poverty and all forms of human life . . ." but it has taken some time to fully realize the impact of this fact on the course his Administration must inevitably take if it is to stand any chance of success.

Now that he is beginning to face up to this challenge of technology as a national policy it is incumbent on the aerospace industry to re-examine its own resources, policies and goals in order to fully and effectively meet this challenge when it is passed on to it for translation from policy to reality. Inevitably the aerospace industry will be the spearhead of this drive aimed at creating the strength required to restrain mankind from destroying itself in nuclear incineration and at providing the new technology required to erase poverty and disease from those sad and unhappy lands that embrace the majority of the world's population.

The role of aerospace technology in welding this required strength is clearly defined and most of its massive technical drive has been directed toward this end. However, the aerospace industry has an equally important role in the campaign to spread technology to the underdeveloped and poverty-ridden areas of the world and this effort could stand considerably more emphasis. Even a person traveling hastily around the globe can feel the impact of post-war air transport in general and that of the giant jetliners in particular on the politics and economics of our times. In Europe particularly, the twin solvents of military and civil aviation have done much to dissolve many of the rigid national boundaries that retarded its economic growth for so many years. In Asia and Africa the full impact of air transport is still to come.

Future Transport Development

The aerospace industry has done a magnificent job in the post-war transport field, particularly in its development of jet airliners. However, a journey along the aerial byways of the world off the main jet routes gives evidence of how well U.S. aviation did its earlier work with piston transports, for along all of these byways the old piston workhorses from Santa Monica, San Diego and Burbank are still plying their trade profitably and reliably like tramp steamers in relation to the sleek blue-ribbon transatlantic liners. But now that the jet job has been largely done there must be some serious thought and effort to developing the type of air transport that can truly serve those vast areas of the world where development of aerial supply and communication lines offers the only hope of economic development.

Our efforts in this area have been feeble largely because financing the purchase of this type of equipment has been difficult if not impossible for the nations that need it most. It is in this area that a new U.S. policy is needed for stimulating development of suitable equipment by the aerospace industry on the one hand and for easy long-term credit for its financing by the user nations on the other. Our policy with the Export-Import Bank has been extremely effective in the long-range transport field, particularly for the high-cost jets, but it has never been adequately projected beyond the periphery of already well-developed economies. The reputation of U.S. aerospace engineers in developing the sound air transports and engines that have been the spearhead of airline expansion all over the world during the past 15 years and the reputation of U.S. aerospace business organizations supporting these transports with spares and services are national assets that should be more widely applied to the new areas where the need for swift development of aerial logistics offers the only real hope for future economic growth.

Challenge to Aerospace Industry

To meet this double challenge the aerospace industry will have to improve its technology, sharpen its sales tools and maintain an aura of integrity above its present standards. We think Joseph V. Charyk, under secretary of the Air Force, expressed this problem well recently in speaking to the scientific and industrial leaders of the aerospace industry gathered in Washington to honor Dr. Theodore von Karman on his eightieth birthday.

His warning bears repetition and we quote: "I am . . . deeply disturbed by all too frequent evidence of the technical irresponsibility of attempts to seek contract gain through dramatic representations to the military of concepts that are technically unsound or highly speculative but are represented as attainable at an early date and at low cost. I see too much of attempts to solve problems by the massive application of manpower rather than by the selective application of brainpower. Sometimes accomplishment seems to be measured by the size of the contracts required to complete the job rather than by the efficiency with which the job was executed. We tend to substitute glossy proposals for sound technical ideas and we often times confuse technical concepts with demonstration models. I believe we have become too enamored of sophistication and too deprecative of simplicity. The dubious luxury of these faults cannot be continued. We must focus our energies in the most efficient fashion we can, for in large measure the destiny of man is linked to how we face up to the new horizon of 1961."

We respectfully suggest that the aerospace industry take a good introspective look at itself with a view toward determining how it can better serve as the keen cutting edge of a new national technological policy that can support our political and economic cause successfully against the challenge of other systems.

—Robert Hotz

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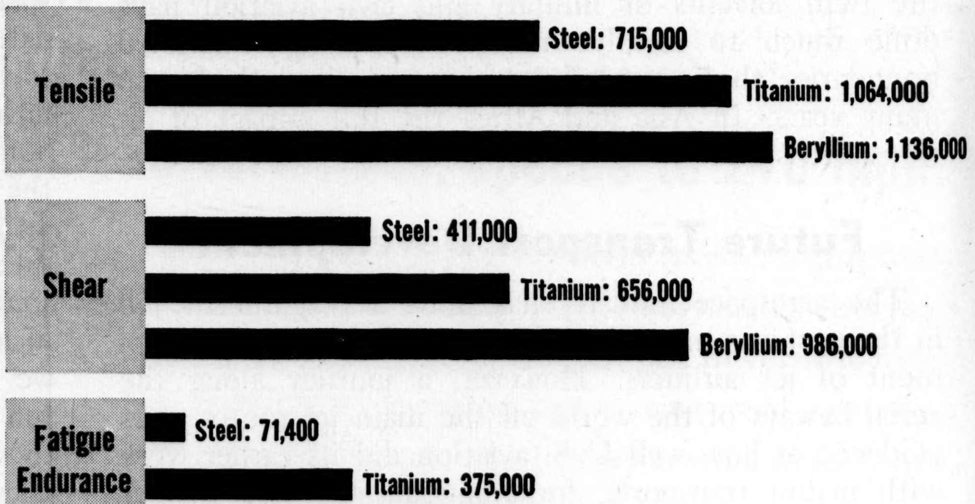
Comparison of mechanical properties—by strength-to-weight ratio—of beryllium bolts with steel and titanium bolts of NAS 464 configuration (values are given in stress/density units—psi/lb. per cu. in.)

Density of beryllium bolts	.066 lb./cu. in.
Density of titanium bolts	.16 lb./cu. in.
Density of steel bolts	.28 lb./cu. in.



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Donald W. Baisch, assistant to the vice president, Telecomputing Corp.'s Electronic Systems and Value Engineered Products Divisions, Los Angeles, Calif.

Maj. Gen. D. C. Doubleday, commander, Rome Air Development Center, Air Force Systems Command, Griffiss AFB, N. Y., as of July 1.

The following Royal Air Force appointments have been announced: **Air Vice-Marshal Charles Broughton,** director-general of organization, Air Ministry; **Air Vice-Marshal Frederick Snowden Stapleton,** senior air staff officer, RAF Transport Command; **Air Vice Marshal John Gerard Wellsley Weston,** director general of manning, Air Ministry; **Air Commodore Peter Theodore Philpott,** senior directing staff of the Imperial Defense College.

Robert W. Landee, a vice president, The Electrada Corp., Culver City, Calif., and general manager of the Electronics Division.

INDUSTRY OBSERVER

▶ First attempt to create a novel type of communications satellite by placing millions of tiny frangible dipoles in low altitude orbits will be made within 60 days by the Air Force. Program, known as Project Westford, formerly was called Project Needles (AW Sept. 19, p. 30).

▶ USAF expects to buy van-mounted, air-transportable search and approach radars and single sideband radio equipment this year in an attempt to improve global war capability. It also has awarded study contracts under the Emergency Mission Support System (EMSS) program to determine what types of avionic systems are needed for the 1965-75 period. EMSS is directed by Cambridge Research Laboratories and Electronic Systems Division and contractors include Airborne Instruments Laboratory, Alpha Corp., Avco, Garrett, Gilfillan, Hazeltine, HRB-Singer, ITT Laboratories, Lockheed, Maxson, North American and Radio Corp. of America.

▶ Flight characteristics of the North American B-70 bomber will be demonstrated as early as possible by flying the first model and then returning it to static test status.

▶ Prototype of the National Aeronautics and Space Administration Grumman orbiting astronomical observatory (OAO) is scheduled for assembly early next year and flight models are to be assembled by the middle of 1962. Satellite will carry a 36-in. reflecting telescope and have a 100-min. orbital period.

▶ Development problems with radiometers in the infrared subsystem for National Aeronautics and Space Administration's Tiros weather satellites have delayed launching of Tiros III from the second to the third quarter of this year. Backup launch attempt would be made before the end of the year if first attempt to launch Tiros III failed.

▶ USAF has asked Hercules Powder Co. to investigate propellant slurry processes for the manufacture of Minuteman third-stage rocket motors. Hercules now uses the dry cast system for this motor.

▶ Use of a large solid propellant booster, plus the Martin Titan II as a launcher for orbital Dyna-Soar flights, is being considered by USAF. Titan II plus a liquid hydrogen-liquid oxygen stage also has been proposed.

▶ Deficit in the procurement of naval aircraft for annual replacement will result in an increase in six-year-old aircraft from 23% on June 30 to about 50% by the end of 1963. Average expected life of a naval combat plane is five years.

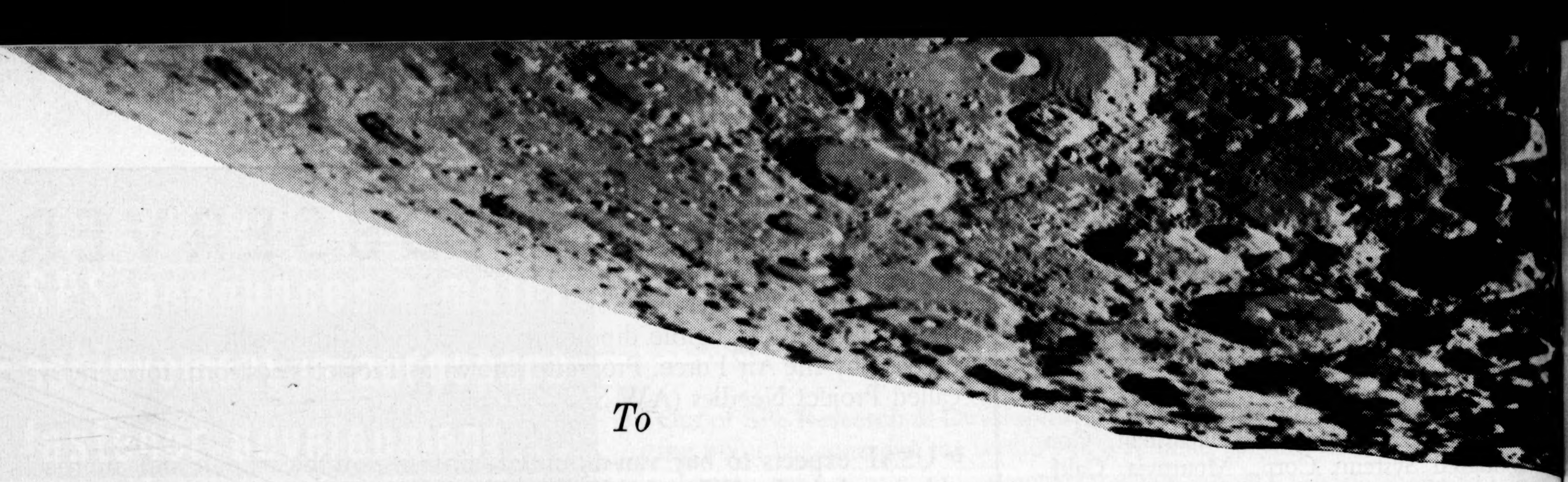
▶ Army Transportation Research Command is accepting bids on a contract to study ways of substituting elastically deforming structural members for the troublesome hinges in helicopter rotor heads. Simplification studies are considered the first step in cutting the number of heavily loaded, dust-vulnerable bearings that have been a prime source of maintenance problems.

▶ Experiments for the S-55 micrometeorite hazard satellite, to be launched from Wallops Island, Va., in about a month, will be wrapped around the final stage of the Scout launch vehicle. The 115-lb. payload is intended to orbit from 280 to 740 naut. mi.

▶ Solar energy power supply is programed for NASA Centaur- and Saturn-launched payloads for missions planned through 1968. Meanwhile, Hughes Aircraft is evaluating the use of radioisotope thermoelectric generator (AW Apr. 17, p. 23) for possible use in Surveyor lunar payloads after they have been soft-landed.

▶ Portion of the $113 million in operating funds requested by Navy for the Pacific Missile Range for Fiscal 1962 will be spent to convert a Victory ship hull into a range instrumentation ship.

▶ Television scanner is under development for a NASA Mars probe, along with spectroscopic and magnetic and electrical field instrumentation.



To

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Motorola

systems

reliability

CALTECH'S JPL RANGER, to carry research instrument packages to the moon, will rely upon precision design, construction, testing and performance of Motorola electronic equipment. Comprehensive measurements of operational and navigational data aboard will be assembled for transmission by its Flight Data Encoder. An all solid state Transponder generates the telemetry carrier, receives ground commands, and translates carrier frequencies for two-way Doppler velocity measurements. ☆ In laboratories and at launch site, Payload Test Sets will check out the spacecraft RF communications system. At NASA's transmitter and receiver sites, Calibration Beacons will check command transmitter performance and radiate precise signals to test telemetry receivers. ☆ Motorola's participation in Ranger lunar probes demonstrates its space communications capabilities for frontier programs.

Military Electronics Division MOTOROLA

Qualified technical personnel are invited to apply

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SCOTTSDALE, Arizona, 8201 East McDowell Road
RIVERSIDE, California, 8330 Indiana Avenue

Washington Roundup

Arms Control Action

Kennedy Administration is expected to launch a major scientific and technological program to develop detection and monitoring systems for all types of weapons. The President has long felt that this is the key to any realistic arms control program. Work will be directed by a new executive agency—probably a semi-autonomous unit within the State Department.

Draft legislation authorizing the new agency was formally submitted to the President last week by John J. McCloy, his disarmament adviser. It already has been reviewed by top officials in other departments that would be affected.

Space Task Group, the team that directs manned space flight projects for National Aeronautics and Space Administration, may be moved from Langley Field, Va., to Houston, Tex., or Tampa, Fla., in what would be explained as an effort to spread space activities around the country rather than concentrate them on the coasts.

A move to Texas might make Vice President Lyndon Johnson, who heads the National space council, a target for criticism. But NASA believes that more complete acceptance of space costs—which could grow to $5 billion annually with a crash lunar program—depends on dispersal of facilities.

The task group successfully fought a plan two years ago to shift it to the Goddard Space Flight Center near here. Earlier this year, STG was increased to the status of a manned space flight center and it was thought that it would move to Ames Research Center in California. If the group goes to Florida it would use the deactivated McDill AFB; if it moves to Texas it probably would use Ellington AFB.

Apollo project team, which NASA wants to increase from 75 to 375, could relocate at any time but the 700 members of STG now working on Project Mercury probably would not be transferred until the manned orbital program is completed next year.

Tri-Service Fighter

Tri-service tactical fighter recommendations prepared by a Defense Research and Engineering Office committee were forwarded to Defense Secretary Robert McNamara last week. They call for a vehicle which could operate from hard coral, has variable geometry wings and would be suitable for interdiction, air superiority and reconnaissance. Requests for proposals would go out in about 60 days, to be followed later with requests for proposals on a separate close support fighter that could operate from sod.

Partly because he has been criticized for bypassing the Joint Chiefs of Staff, McNamara has sent the recommendations to them. Navy still wants to develop its own tactical fighter, and regardless of what new development is decided on, an interim purchase of some existing tactical fighter is still planned.

Adm. Arleigh Burke, chief of naval operations, has spent so much time around the White House recently that there is speculation in the Pentagon that he might become a special military adviser to the President, as Fleet Adm. William Leahy was to President Roosevelt in World War II.

Look for more changes in the Defense Research and Engineering Office in spite of the reorganization moves that have taken place in the last three months.

Latest shift is the abolition of assistant directorships for naval and tactical weapons and creation of an assistant directorship for limited warfare systems. Duties of this office include guerrilla and counter-guerrilla warfare systems.

Frank A. Parker, who held the naval weapons job, heads the new office. F. W. Wolcott, who had the tactical job, has left government service.

Oceanography Spurred

Congress is pressing for a "road map of the seas" on the theory that they may become the decisive battleground. President Kennedy earlier this year bemoaned the fact that "we do not have adequate charts of more than 1 or 2% of the oceans." A bill authorizing the Coast Guard to perform charting and other oceanographic work while on sea patrol is expected to be passed soon, and more oceanography money is coming from this Congress. These actions follow passage last year of a bill allowing the Coast and Geodetic Survey to work on the high seas instead of being confined to within three miles of U. S. shores.

Some lawmakers and Administration officials are fervently hoping that Rep. Victor Anfuso's proposed "Star of Hope" satellite never gets off the ground. It would be star-shaped, cost $15 million, be launched around December and broadcast peace messages in various languages from world leaders.

Critics see numerous propaganda and other problems, but Anfuso told Aviation Week his subcommittee will hold hearings on his resolution calling on the President to approve the satellite, and he will ask Senate space committee Chairman Robert Kerr to introduce a similar resolution in the Senate.

—Washington Staff

FIRST PROTOTYPE of Potez-Heinkel C.M.191 executive turbojet transport is shown at Paris Air Show pavilion of Heinkel Flugzeugbau with a protective covering. Aircraft, which has not made its first flight, is an outgrowth of the two-place Potez-Fouga Magister jet trainer. Four-place C.M.191 has a maximum speed of 384 kt. without wingtip tanks, maximum range of 1,318 mi. with tip-tanks.

European Aircraft Industry Shows Post-War R

By Cecil Brownlow

Paris—Resurgence of Europe's post-war aviation industry and its increasing ability to stand on its own in the design and production fields is reflected in the displays and exhibits of the 24th Paris International Air Show.

Fourteen nations are represented at the show, including the Soviet Union and Czechoslovakia, the two industrial powers of Eastern Europe, and over 90 different types of aircraft and helicopters are scheduled to take part in the flying demonstrations during the final two days of the show—June 3 and June 4. Of these, more than 60 were produced in Europe, although some are based upon United States designs, particularly in the helicopter field.

The show, which opened late last week at Paris' Le Bourget airfield, has a total of 312 individual exhibitors, a 10% increase over the last display in 1959. These have contracted for approximately 20% more space to show their wares—1,230,000 sq. ft.

Political pressures, however, intervened to cancel the scheduled high point of the exhibit, which also would have provided the show with its most tangible association with the space age.

The Union Syndicate des Industries Aeronautiques, trade association of the French aviation industry and sponsor of the show, had invited Soviet Cosmonaut Maj. Yuri Gagarin and American Astronaut Cdr. Alan Shepard, the first two men into space, to appear at the show on May 31, a day devoted to space, to hold a joint press conference. Both had accepted before French political circles learned of the bids and ordered the invitations withdrawn since their arrival in Paris would have coincided with President Kennedy's visit to President de Gaulle.

The Soviet Union, however, will still be amply represented. Sticking to its traditional propaganda approach of exhibiting only peaceful objects at international fairs, the Soviets are scheduled to show three transport designs—two of which are making their first appearance in the West.

Newest of the lot is the Tupolev 124 medium-range transport powered by two Soloviez turbofan engines and with an estimated maximum speed of approximately 620 mph. Other new aircraft is the Antonov 24, which also is used as a military and troop transport, powered by two Ivchenko turboprop engines producing an estimated 2,000 eshp. each. Also scheduled for display is the older Antonov 10 Ukraine with four turboprops of approximately 4,000 eshp. each.

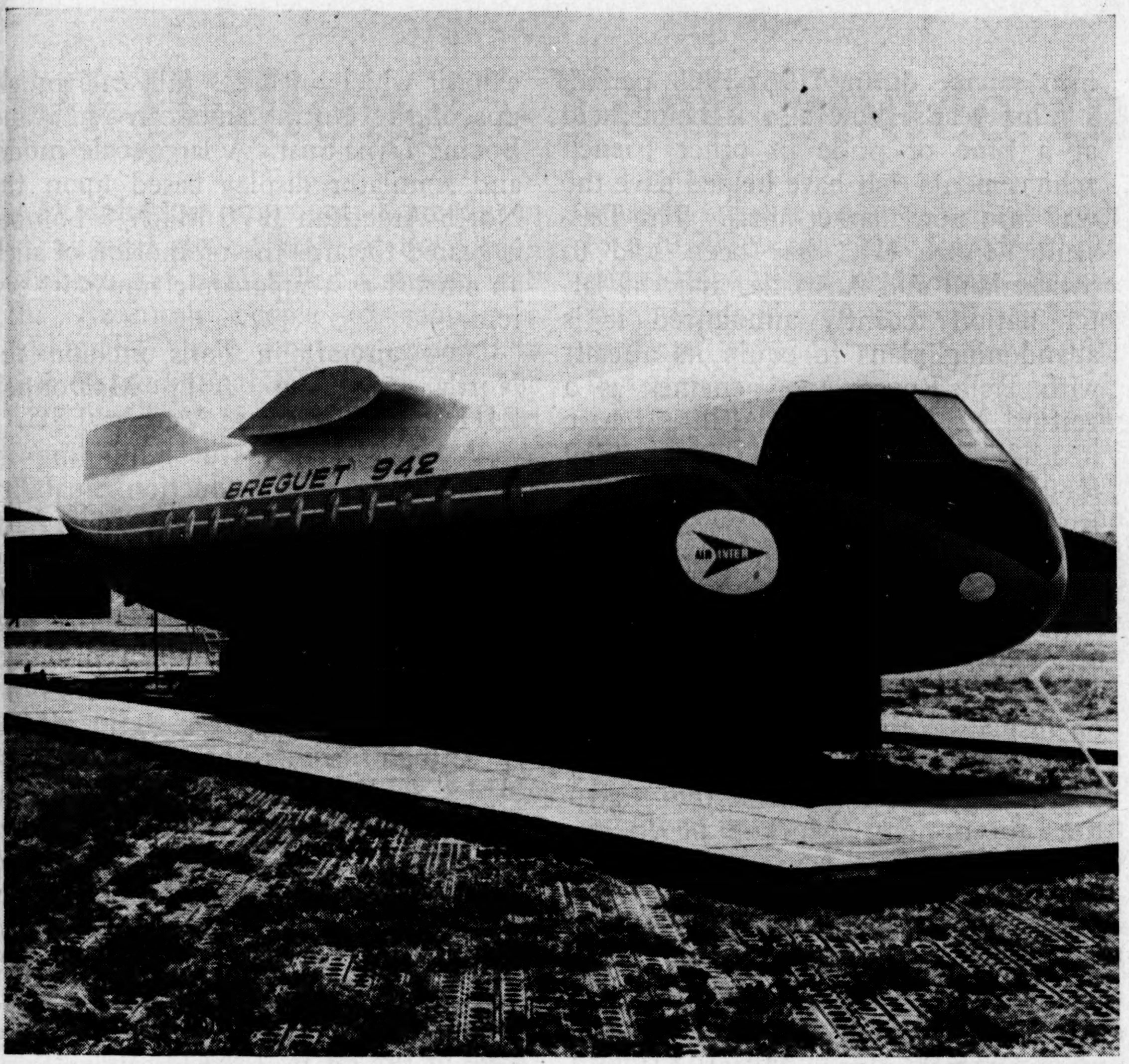
Newest aircraft of the host nation on display—a joint development with Germany—is the first prototype of the Potez-Heinkel C.M.191 four-place executive jet transport, an outgrowth of the highly-successful Potez-Fouga Magister C.M.171 trainer.

Powered by two laterally-installed 1,058-lb-thrust Turbomeca Marbore 6 powerplants and scheduled to sell for an estimated $275,000, the C.M.191 was trucked to the show from the Heinkel factory where it was built and presently has zero hours flying time.

On static display as the feature of the Heinkel exhibit, the aircraft will begin its flight test trials immediately after the show.

The aircraft, when equipped with two optional wingtip tanks of 85 U.S. gal. each, has a projected maximum range of 1,318 mi. at an altitude of 29,500 ft. Maximum range without tip-tanks is quoted at 976 mi. Maximum speed without tip-tanks is 384 kt., cruising speed 358 kt. With the 85-gal. tanks installed, the aircraft has a maximum speed of 367 kt., a cruising speed of 334 kt.

The newer French aircraft in general

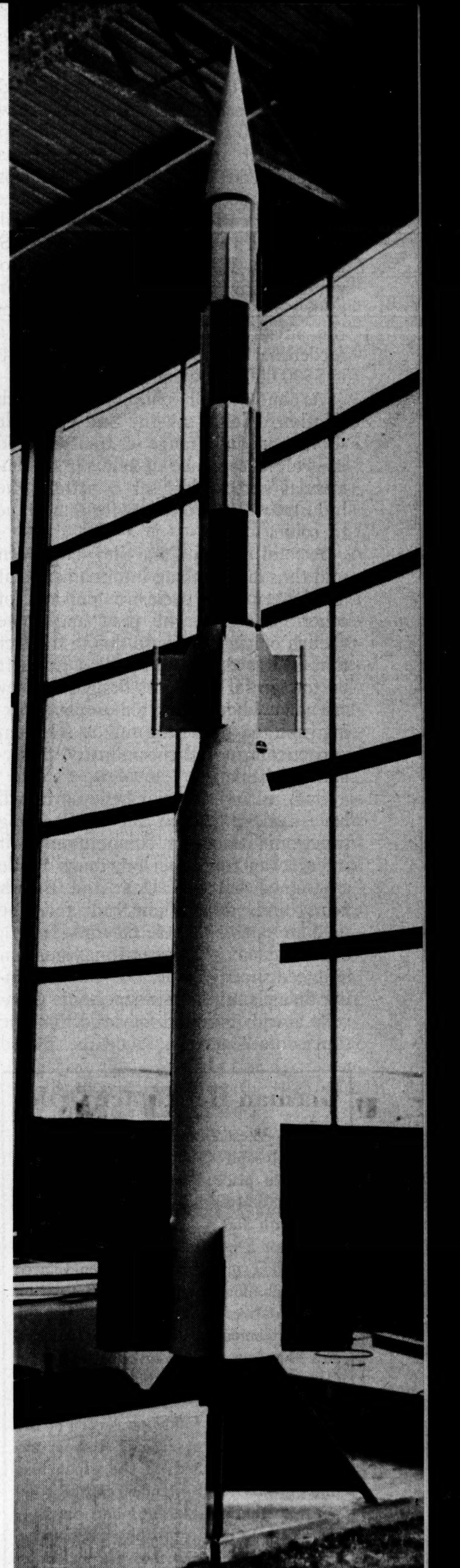


FUSELAGE MOCKUP of the Breguet 942, pressurized version of the 941 STOL cargo-passenger transport (AW May 15, p. 38), is on static display. Now beginning its flight trials, the 941 was not scheduled to participate in the show.

Resurgence at Paris Air Show

are clustered around the general aircraft field as the industry makes a serious effort to compete in performance and price with U. S. counterparts and to fill any existing gaps. Aircraft on display include:

- **Gardan GY-80** all-metal four-place lightplane that sells for approximately $13,200, including radios and French taxes. With a maximum gross weight of 2,204 lb., the GY-80 has a maximum sea level speed of 162 mph., a cruising speed of 155 mph. at 6,560 ft. with 75% power. Standard powerplant is the 150-hp. Lycoming O-320-A engine, but a 160-hp. B version also can be installed. Maximum range without reserves is about 714 mi. Gardan is currently negotiating with a U. S. firm for rights to assemble and sell the four-place aircraft there.
- **Morane-Saulnier 880 Rallye.** Although the fourth prototype of the Rallye, with a yoke control column rather than the conventional stick that characterized the earlier models, is only scheduled to make its first flight this week, Morane-Saulnier says it already has 356 firm orders for the Rallye—144 in France, 211 in 23 other countries. The company plans to reach a production rate of 30 aircraft per month in August and jump to 60 per month next March. The all-metal two-place craft can be fitted with either a 100- or a 145-hp. Continental engine. For the smaller-engined plane, maximum speed is 111 kt., cruising speed 100 kt. and maximum range 500 mi. The larger super Rallye has a maximum speed of 124 kt., cruising speed of 113 kt.; range remains the same. Fourth prototype is scheduled to make a sales tour of the U. S. after completion of flight trials. Estimated U. S. sales price is $5,995 for the 145-hp. version, $5,750 for the 100-hp. plane.
- **Max Holste 250 Super Broussard** feederliner. With a tentative factory price of $225,000, the company says it now has options for about 80 aircraft, including a sizable Australian order. Powered by two 1,000-hp. Turbomeca Bastan 4 turboprop engines, the government-supported Super Broussard has a cruising speed of 210 kt. and can clear a 35-ft. obstacle 1,640 ft. from the start of takeoff roll. Plan for a scaled-down version of the aircraft, designated the M.H. 350 Major and powered by two 315-hp. Continental engines is under study.
- **Scintex ML 145 Rubis.** Rubis, a four-seat low-wing monoplane with retractable landing gear and powered by a 145-hp. Continental engine, still had not made its first flight early last week although it was originally scheduled to begin flying last fall. Scintex, however, hopes to fly the plane to Le



TWO-STAGE high altitude research rocket on display at Sud Aviation stand was built for ONERA, French counterpart of the National Aeronautics and Space Administration.

Bourget by June 1. Price also is scheduled to be announced during the show.

- **Potez 840 turboprop transport** (see p. 71). First prototype of the 24-passenger aircraft made its initial flight on Apr. 29. Second prototype, scheduled to roll out early next year, probably will be used as a demonstrator in the U. S. by Turbo Flight, Inc., of Chicago, which is now negotiating for American sales rights. Estimated sales price for the aircraft, which can be used as a feederliner or as an executive transport, is $500,000, fully equipped.

As an over-all philosophy, French aviation officials say the Sud Caravelle short-to-medium range jet transport and its wide acceptance—if not yet a commercial success—has set a pattern the industry will try to follow for some time to come.

A total of 116 Caravelles have been sold thus far, breaking into markets that have been the exclusive purview of other nations in the past, and some French officials attribute this to the fact that it was designed to fill a gap left by foreign jet transport designs. They are now widening this philosophy—seeking gaps and then designing to fill them—to encompass all the industry, particularly lightplanes.

Sud, as an example, believes it will have a clear field in the forthcoming supersonic transport competition if it steers away from the long-range battle envisioned between U. S. and British firms and designs instead for the medium-range market. Georges Hereil, Sud president and general manager, announced shortly before the show's opening that planning for a supersonic Caravelle already is under way and that the supersonic Caravelle could be placed into service during 1967-1968 period.

German Helicopter Order

Paris—West German Defense Minister Franz Joseph Strauss apparently has agreed to place West Germany's major and long delayed heavy turbine helicopter order with Sud Aviation for the S.E.3210 Frelon or a possible follow-on.

Decision reportedly has been relayed to French officials, although Sud Aviation representatives said last week that no firm agreement has yet been reached and that no papers have been signed. Quantity of the order has not yet been determined.

Sud's 3210 is a follow-on version of the 3200 prototypes now flying, but no aircraft have yet rolled off the production line. Two U. S. contenders in the competition, the Sikorsky S-61 and the Boeing Vertol 107, probably could have been delivered earlier, but the Sud order follows the line of a German-French-Italian agreement signed in 1958 for cooperative helicopter development and production.

This year's show also is being held at a time of pride in other French achievements that have helped pave the way into new market areas. The Dassault Mirage IIIC has been sold to Switzerland and Australia, and the latter nation recently announced it is abandoning plans to equip its aircraft with Rolls-Royce Avon engines as a gesture to Britain and will purchase instead the Snecma Atar 9 intended for the Mirages of France and Switzerland.

The Sud Alouette helicopter, another gap filler, also is enjoying success, with 775 total sales within a number of nations thus far. Morane-Saulnier's 760 four-place executive jet transport on display at the show has found limited success abroad with approximately 100 sales, including 50 to the Argentine government. Mockup of an envisioned five-place version of the aircraft also is on display.

In all, France will have approximately 35 aircraft and helicopters in the flying display, including the Mirage III and IV, the Breguet 1050 anti-submarine search plane, Alouette II and III and the prototype of the Sud S.E. 3200 heavy helicopter, the Mk. 6 version of the Caravelle and approximately 10 lightplanes.

Several of France's more promising aircraft are coming off the line too late for the show, including the Breguet 1150 Atlantic being built by a European consortium for the North Atlantic Treaty Organization, the Nord Transall turboprop transport being built in France and Germany and the Breguet 941 cargo-passenger transport (AW May 15, p. 38). Although originally scheduled to be shown and rolled out for the first time on May 1, the 941 is not now scheduled to participate. Full-scale fuselage mockup of the 942 pressurized version is on display, however.

Latest example of U. S.-French cooperation on display here is the Mk. VII version of the Caravelle powered by two General Electric CJ-805 aftfan engines. The Mk. VII, flown from the U. S. to be in the show, will make a sales demonstration tour of Europe and the Middle East before returning.

The U. S. is making one of its largest and most current contributions within recent years, and the Navy, which failed to participate in 1959, is back in again this year.

Late-model aircraft on display include the Air Force's Convair B-58 supersonic bomber, Boeing B-52G, Republic F-105, Lockheed F-104 and the North American T-39 and Northrop T-38 trainers. The T-38 has been in West Germany for evaluation by the German air force and probably will return there after the show.

Air Force also is sponsoring a space exhibit which includes full-scale mockups of the North American X-15 and Boeing Dyna-Soar. A large-scale model and simulator display based upon the North American B-70 Mach 3 bomber is geared towards the promotion of such an aircraft as a supersonic transport system.

Navy aircraft in Paris include the North American A3J, McDonnell F4H and the Chance Vought F8U.

West Germany, still rebuilding its technological and production capability for sophisticated, high-speed aircraft, is well represented in the lightplane exhibit with the Dornier Do.27 and Do.28, the four-seat Bolkow 207 and the "Bolkow Junior," a Swedish design which Bolkow will produce.

Highlight of Bolkow's static exhibit is a high-speed rotor system whose blades fold inward during the "non-pulling" regime of their spin in order to minimize the problems of hypersonic vibration at the tips. Bolkow says it has successfully tested the system in the wind tunnel at speeds of over 370 mph. It plans to build a helicopter around the system which it hopes to have in the air by 1963.

Italy's contributions include the Macchi Lockheed 60 utility aircraft and the Agusta Bell 47G3, 47J3, 102, 104 and 204B helicopters.

Britain, France's greatest West European competitor, has on hand the Short SC-1 VTOL experimental aircraft, English Electric P.1 Lightning interceptor, Avro Vulcan and Handley Page Victor strategic bombers, the Percival Jet Provost jet trainer, de Havilland Heron and the de Havilland Caribou.

Czechoslovakia, Russia's East European partner at the air show, is represented by the Morava L-200 business plane which is making a strong bid for West European and South American markets.

Grumman-Breguet Pact

Paris—Grumman Aircraft Engineering Corp. and Breguet last week announced a reciprocal technical interchange agreement that could lead to U. S. production of the Breguet Atlantic turboprop antisubmarine aircraft and European production of the Grumman Mohawk.

Although the joint release on the agreement made no specific reference to such production, Grumman probably would build the Atlantic under license if the U. S. Navy should decide to order the aircraft for its own use or if American mutual aid funds are used to finance such purchases to countries outside Europe.

The Mohawk, in turn, would be built in Europe if Grumman's current European sales campaign for the aircraft should pay off in substantial orders.

$9-Billion, 5-Year Space Increase Asked

Washington—President Kennedy in an unusual second State of the Union Message last week asked Congress and the American people to support a "dramatic" space program expected to cost an additional $9 billion over the next five years, and to approve other emergency defense and economic measures.

Citing the impact of recent space achievements, the President said: "Now it is time to take longer strides—time for a great new American enterprise—time for this nation to take a clearly leading role in space achievement."

President Kennedy cautioned that "while we cannot guarantee that we shall one day be first" in space, "we can guarantee that any failure to share this effort will make us last. . . . Space is open to us now; and our eagerness to share its meaning is not governed by the efforts of others. We go into space because whatever mankind must undertake, free men must fully share."

The President said the "new course of action" in space "will last for many years and carry very heavy costs—an estimated $7 billion to $9 billion additional over the next five years."

This will bring the total that the nation is being asked to spend to well over $10 billion between now and July 1, 1966. The mood in Congress is to appropriate as much or more money as space agencies request, as witnessed by the House passage Wednesday of a bill authorizing more money than the National Aeronautics and Space Administration requested.

President Kennedy said he was breaking the tradition of delivering an annual State of the Union Message because "we face an extraordinary challenge." His requests for congressional action centered on meeting the Communist challenge in such critical areas as Latin America and Southeast Asia and bolstering U.S. cold and hot war machinery. His major requests:

- **$679 million more** for space in Fiscal 1962, with $531 million going into an effort to send a man to the moon and back.
- **$250 million additional** for an emergency presidential fund to aid foreign countries suddenly threatened with Communist domination.
- **$285 million more** for the military assistance program, partly to help foreign countries develop effective guerrilla forces.
- **$121 million more** for the U.S. Information Agency to provide more broadcasts for Latin America and Southeast Asia.
- **$100 million more** to modernize and increase Army mobility and $60 million more to increase Marine Corps strength to 190,000 men. The President also said $100 million of Defense Department funds already in hand would be used to expand para-military operations.

President Kennedy said all these increases could be financed without revising the tax structure beyond his previous recommendations. He said he would ask Congress later to triple the amount of civil defense money previously requested for Fiscal 1962. He said he was putting the civil defense program under the Secretary of Defense and downgrading the existing Office of Civil and Defense Mobilization to a co-ordinating agency. The President promised to submit to Congress later a plan for retraining workers displaced by automation.

NASA's Fiscal 1962 request is now 61% more than Eisenhower requested in January. Kennedy Administration actions add $376 million to the research total, $143 million for construction and $30 million to support 3,300 new employes (see box).

Most significant increases go to the man-in-space and large booster development programs. Apollo will get $130.5 million more in research funds, a $60 million laboratory, a $5 million tracking station, $7 million to add 800 new employes to the Space Task Group (see p. 26).

Other research increases will go for the following:

- **Lunar and planetary exploration,** $56 million, principally for basic studies for manned lunar flight.
- **Nova, a new program,** $48.5 million and expected to resolve whether the configuration will have a liquid or solid booster.
- **Weather satellites,** $22 million to add two more Tiros flights, accelerate Nimbus development and begin Aeros development. Weather Bureau will get $53 million to push a world-wide satellite net based on Nimbus.

In addition to a new manned space flight laboratory (see p. 25), construction money is for Nova development and launch facilities, $58 million; Rover test facility, $15 million; and advanced facility planning and design, $5 million.

Air Force would receive $62 million for development of solid boosters to be used both by it and NASA, and $15 million for development of Titan II as a backup launch vehicle.

To finance a complete reorganization of the Army's divisional structure, increase non-nuclear firepower and improve mobility, the President asked for an added $100 million. The new Army money and other reprogramed funds would go for purchase of new helicopters, armored personnel carriers and other equipment.

The existing three Marine divisions and three air wings would have their manning level increased. Current Marine strength is 176,208. Original Fiscal 1962 request called for 178,000. New money would also add two helicopter squadrons.

Army reserve response to an emergency would be enhanced in that two divisions with 89,000 men could be ready for operations on three weeks' notice and two more divisions with five week's notice. Six additional divisions could be deployable with their supporting forces in eight weeks.

NASA Fiscal 1962 Program Summary

(000 Omitted)

	Original January	Revised March	Current Recommendation
Unchanged projects	$152,830	$152,830	$152,830
Support of NASA plant	74,310	77,110	89,110
Life sciences	8,620	8,620	20,620
Sounding rockets	7,000	7,000	9,000
Scientific satellites	64,700	64,700	72,700
Lunar, planetary exploration	103,899	103,899	159,899
Meteorological satellites	28,200	28,200	50,200
Communication satellites	34,600	44,600	4,600
Apollo	29,500	29,500	160,000
Launch vehicle technology	15,000	15,000	27,000
Launch operations development	9,500	1,500	1,500
Liquid propulsion	68,700	78,020	93,020
Nuclear systems technology	24,000	28,000	36,000
Centaur	30,800	56,400	56,400
Saturn	168,160	224,160	224,160
Nova	....	....	48,500
Total R&D appropriations	$819,819	$919,539	$1,295,539
Total construction	$99,825	$119,075	$262,075
Total salaries and expenses	$189,986	$196,686	$226,686
Total requests	$1,109,630	$1,235,300	$1,784,300
Employe strength	17,342	18,122	21,422

Increased Apollo Appropriations To Accelerate Design, Hardware

Washington—Price tag of $20-40 billion put on the manned lunar landing program includes the complete cost of the Apollo project, a substantial portion of the Saturn development program, development of advanced spacecraft and components, plus construction of new launch and tracking facilities.

Some potential prime contractors of the Apollo and lunar landing vehicle spacecraft argue that the cost estimate is too high, and the flight schedule announced by the National Aeronautics and Space Administration too conservative. NASA greatly underestimated the cost and time of Project Mercury, however, and feels on solid ground with the projected figure for completion of the manned lunar landing program.

As the step immediately preceding the lunar mission, Apollo spacecraft development has a cost estimate ranging from $700 million to something more than $1 billion. This figure does not include launch vehicle costs, which could more than double the estimates.

Twenty-five of the first 33 Saturn launch vehicles have been committed to Apollo development and operational flights. Boilerplate spacecraft will be flown on eighth and ninth Saturns, and the first prototype vehicle flight on Saturn No. 11, now planned in 1965. NASA has marked 16 C-1 Saturns and nine C-2 Saturns for Apollo.

A DX priority for the manned lunar landing program means NASA can speed:

- **Contract award** for detailed design and hardware. Under the present plan, this award was to be in January (AW May 22, p. 24).
- **Crew selection,** and determination of the scientific disciplines in the three-man crew.
- **Development flights** now scheduled to be made over a two-year period from 1962-1964. Manned flights will begin in 1966-67 under the accelerated funding schedule.

Prime Contracts

NASA may attempt to expedite the program by awarding several prime contracts, possibly one for the structure, another for systems integration and others for major systems. Single prime contractor was selected for the Mercury capsule.

Convair-Astronautics, General Electric, and Martin Co., in Apollo feasibility studies recently completed, suggest semi-ballistic configurations, basically blunt cone lifting bodies. The proposals and photographs have been classified secret by NASA.

The three companies recommend use of the modular concept, with command, propulsion and mission sections, and that mission abort rockets be fueled with liquid oxygen-liquid hydrogen.

NASA specified the spacecraft must be capable of two-week to two-month earth orbital missions, and the environmental systems recommended in the study contracts call for atmospheres ranging from 7-10 psia. during the entire period. The Mercury environmental system operates at 5 psia.

Number of flights proposed ranges from 25 to several dozen, all based on Saturn for manned missions.

Martin has independently proposed that Titan II be used for early Apollo flights.

Spacecraft pad weights range from 18,000-20,000 lb. Lengths are about 30 ft., and maximum diameters, 14.5 ft. so that they can be accommodated on the Saturn S-IV third stage.

NASA Administrator James E. Webb said last week that the agency will recruit new astronauts for the Apollo program, but project officials say the selection phase has not yet been considered. NASA would like to keep all seven Mercury astronauts for Apollo, for their engineering and space flight experience. All are career military officers.

Although the Mercury astronauts also are engineering test pilots, it is probable that medical and physical disciplines will be represented in Apollo crews.

Germans Build High-Altitude Glider

West Germany's equivalent of the Lockheed U-2, a high-altitude powered glider, is being completed for atmospheric studies by Munich's Institute for Aeronautics. First flight tests are scheduled for late this year.

The two-man crew will be able to stay at altitudes up to 60,000 ft. for four hours, out of a total flight plan of seven hours' maximum endurance with range up to 1,800 mi. About 450 lb. of instrumentation can be carried as payload.

Primary mission—study of the structure and turbulence of jet streams—dictated the design load factor of 12. Feature of the aircraft is an automatic flight control system that keeps the angles of the three flight references axes constant in space so that the glider may only translate, not rotate, under the influence of turbulence.

Secondary missions include radiation measurements, photography, meteorological work, and other tests which require a vehicle of this type.

Powerplant for the aircraft is a Pratt & Whitney JT12A-6 turbojet rated at 3,000 lb. sea level static thrust. The straight wing has a span of about 100 ft., an area of about 500 sq. ft., and aspect ratio of 20. Gross weight at takeoff is about 7,300 lb., which gives a takeoff wing loading approximating 14.6 psf.

Over-all fuselage length is about 55 ft. The two-man crew sits tandem in a pressurized cabin well forward of the wing.

Rate of descent as a sailplane is 6.5 ft./sec. at 46,000 ft., and 8.2 ft./sec. at 60,000 ft.

A series of these aircraft will be constructed.

Charyk Presses For Space Simplification

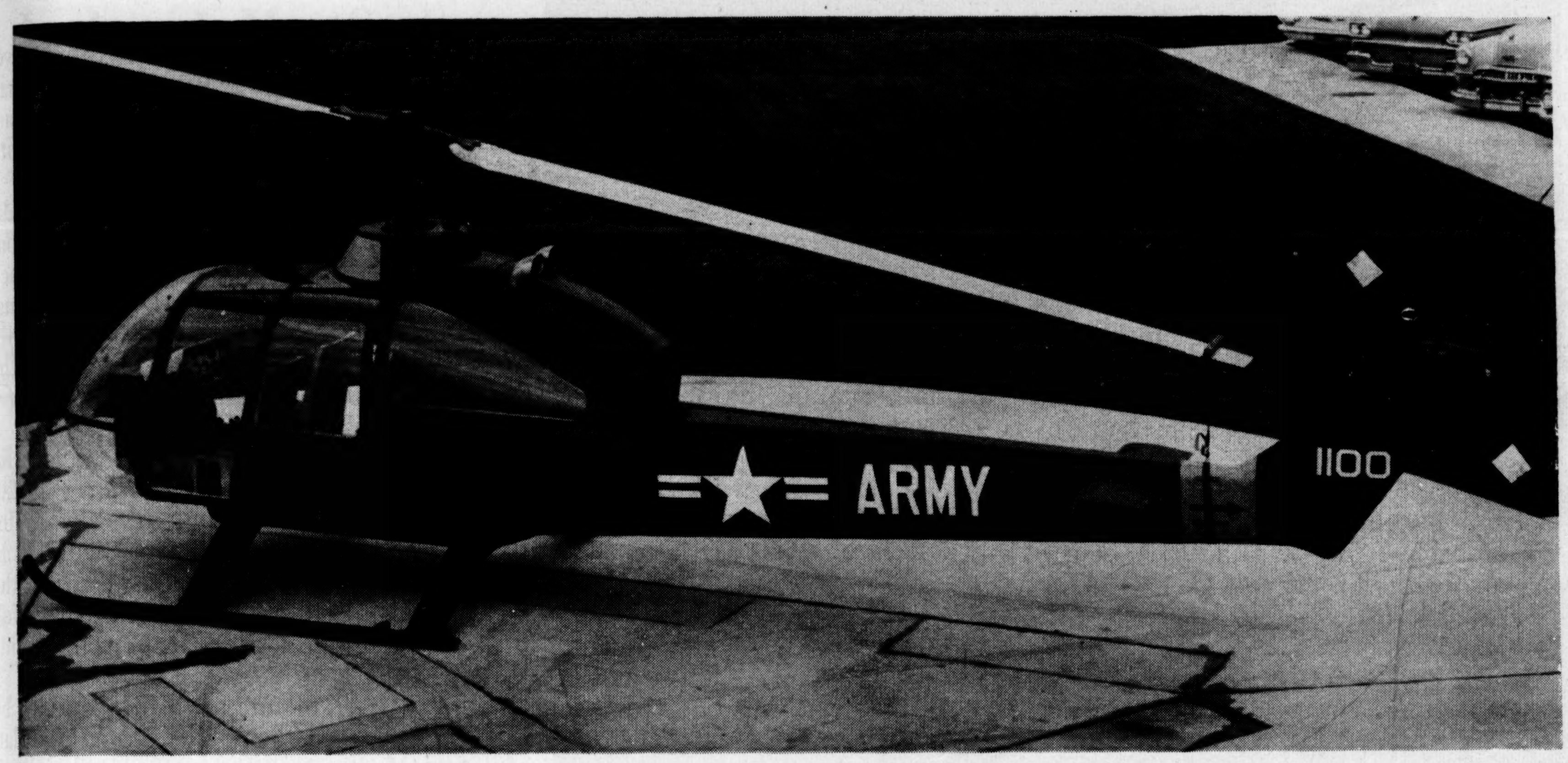
Warning that the nation's resources are not adequate to cover all the "aspirations of the wildest minds" in space projects was voiced by Dr. Joseph V. Charyk, under secretary of the Air Force.

In a speech delivered in Torrance, Calif., Dr. Charyk stated that space technology may open completely new fields of military operations, some of which could well be decisive to our national security.

"It becomes vital that we move forward on this new frontier with vision and with foresight," he said. "It is, however, a field of endeavor where we must plan more carefully. We must distinguish fact from fancy, promise from hope, and technical feasibility from wishful thinking."

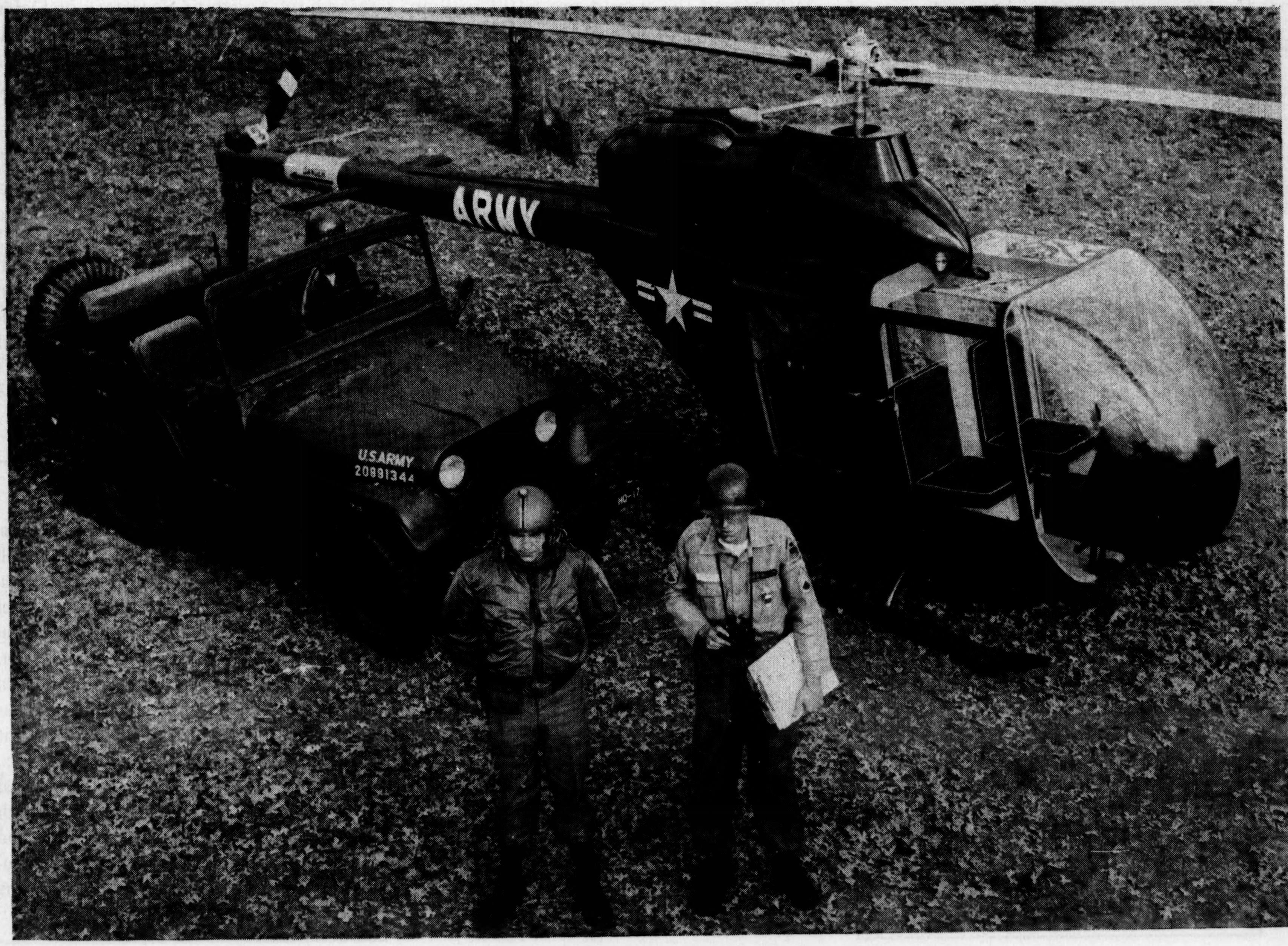
Little has been achieved in simlicity and reliability in the total space effort, he said. "I am afraid that we have been overwhelmed by sophistication and diversification. Very few of the satellite systems that we launch have very many common elements. Each firing is practically a new experiment, and as such, it is not too unreasonable to expect that the accomplishment is normally not in complete accord with expectation."

In defining goals for space Dr. Charyk said that simplicity and similarity are the most important factors that bear on the problem. There are too many different types of boosters and upper stages and these have been different from one firing to the next, Dr. Charyk said.



Hiller, Bell Proposals Win Army LOH Competition

Hiller Model 1100 (above) and Bell D-250 design proposals, recently selected by the Army as the best of 12 proposals submitted for the Army's Light Observation Helicopter (LOH) competition (AW May 22, p. 29), are shown in full-scale mockups. Seven prototypes of each aircraft will be delivered within 15 months to Ft. Rucker, Ala., for evaluation by the Army Aviation Board. Competition winner will go into production in 1963, and will be a single rotor, four-place helicopter powered by an Allison T-63 turboshaft engine, capable of carrying a 400 lb. load in addition to pilot and fuel. Speed capability will be 110 kt. and total inventory may reach 4,000 aircraft. Army's LOH will replace the Cessna L-19, Bell H-13 Sioux, Hiller H-23 Raven helicopters.



More SAC Bombers Authorized As House Adds to FY '62 Budget

By Katherine Johnsen

Washington—House last week followed the Senate in voting quickly and unanimously to authorize over $9 billion for Fiscal 1962 aircraft and missile procurement—including more bombers for Air Force's Strategic Air Command.

The vote was 401 to 0. The authorization to continue buying SAC bombers—probably B-52s—was the only change made by the Senate and the only major change made by the House in the Administration's proposed program (AW Apr. 3, p. 26). Under this, there was no provision for SAC bombers and both B-52 and B-58 production lines would close down in mid-1962.

The $337-million authorization approved last week by the House "only for the procurement of B-52 and/or B-58 bomber aircraft" and the $525-million authorization previously voted by the Senate "only for the procurement of long-range manned aircraft" will now be compromised by a conference committee of the two Houses.

Both Sen. Richard Russell (D.-Ga.), chairman of Senate Armed Services, and Rep. Carl Vinson (D.-Ga.), chairman of House Armed Services, who will lead the conferees, favor the B-52.

Two other additions to the Administration program made by the House—but not the Senate—that will go to conference are: $21.2 million for turbofan engines for 15 Boeing C-135 cargo aircraft in place of turbojet engines; and $25 million for three long-range jet passenger transports for official use.

LeMay Promotion

Washington—Gen. Curtis E. LeMay was nominated last week by President John F. Kennedy to be chief of staff of the Air Force, of which he is presently vice chief of staff.

To succeed Gen. LeMay as vice chief of staff the President chose Gen. Frederick H. Smith, Jr., who currently is commanding general of the U. S. Air Force in Europe and commander of the Fourth Allied Tactical Air Force.

LeMay, 54, has been a general for 18 years, first becoming a brigadier general in September, 1943. He has been associated with strategic bombing since the beginning of World War II and became commanding general of the Strategic Air Command in October, 1948, a post he held until 1957 when he became vice chief of staff.

Gen. Thomas D. White, now chief of staff, will retire.

Meanwhile, Rep. James Wright (D.-Tex.) took his case to channel bomber funds to the Convair B-58 to the House Appropriations Committee, which will act on the appropriations to implement the authorization measure.

"I am convinced we need more B-58 aircraft," Wright told the committee. "For some reason which I have not been able to understand, some military spokesmen have placed a higher priority upon the older and slower and more costly B-52."

Executive testimony before the appropriations group, released last week, shows that the Air Force favors the B-52 over the B-58, but that the B-52 is several steps down its ladder of priorities.

Asked how he would use an additional $300 million. Gen. Thomas D. White, USAF chief of staff, said that first he would allocate $138 million to the B-70 Mach 3 bomber program. This would bring the total Fiscal 1962 allocation to $358 million—the amount recommended by the Eisenhower Administration and reduced by the Kennedy Administration. Second, Gen. White said, he would use $100 million to reinstate two squadrons of Titan missiles deleted by the Kennedy Administration. The $62 million remaining White would use to increase the development effort on the mobile Minuteman solid-fuel missile.

The Kennedy Administration added $230 million to the Eisenhower budget for Minuteman on hardened sites: $140 million for production and $90 million for site construction. The Kennedy Administration cut the allocation for mobile Minuteman by $220 million, reducing the program to a development effort and canceling three mobile squadrons proposed in the Eisenhower budget.

The appropriations hearings were marked by repeated expressions of skepticism on the cutback in the mobile Minuteman program—and that a mobile missile force ever would be developed. The Administration has no plans for operational trains to accommodate Minuteman, testimony disclosed.

Rep. Daniel Flood (D.-Pa.) interpreted that the program has been given "the kiss of death."

Flood added: "The fact remains that there is no programing, no schedule, no talking, no thinking, about a mobile Minuteman on a railroad car as of now in the year before us. It is out."

Asked doubtfully by Rep. George Mahon (D.-Tex.), chairman of the appropriations subcommittee on the armed services, whether there ever would be an operational Minuteman system, Gen. White replied: "I am optimistic that we will go ahead with the system but on a deferred basis."

In later testimony, Gen. White declared that "the preponderance of our missile force must be in the hardened and dispersed configuration." Challenging Navy testimony on the Polaris missile, he commented that "one of the reasons is that with any mobile system you sacrifice accuracy."

Repeating his opposition to any increase in the Administration's $220-million B-70 development program for Fiscal 1962, Secretary of Defense Robert S. McNamara stated during the hearings that it does not have the following characteristics which he wants in a successor to the B-52:

"A type of aircraft which might be thought of as a mobile launching platform for certain types of missiles—such as a variation of Skybolt—a standoff launcher . . . that could be maintained in the air for long periods of time and which, therefore, did not run the risk of being destroyed on the ground but which did not penetrate the airspace over the target in the way that the B-70 would have to penetrate, and which was not subject to the risks of air defense losses that the B-70 is subject to."

Financial plans presented to the committee by Assistant Secretary of Defense Charles J. Hitch, comptroller, showed these trends in obligations—reflecting contracts let—and expenditures—reflecting payments to contractors:

- **Aircraft.** Obligations will decline from $6.8 billion in Fiscal 1961 to $5.6 billion in Fiscal 1962. Expenditures will increase from $6 billion to $6.1 billion. In Fiscal 1960 obligations totaled $5.4 billion and expenditures $6.5 billion.
- **Missiles.** Obligations will decline from $4.1 billion in Fiscal 1961 to $4 billion in Fiscal 1962. Expenditures will rise from $4.1 billion to $4.2 billion. The Fiscal 1960 totals were: obligations, $3.5 billion; expenditures, $3.8 billion.

Satellite Altitude

Chicago—Current data on the inner (proton) Van Allen radiation belt indicates that commercial communications satellites may need to operate at altitudes above 10,000 mi. if their solar cells are to have reasonably long life, Dr. George Mueller told the Fifth National Conference on Global Communications last week. Dr. Mueller is vice president of Space Technology Laboratories, Inc., which has built the payloads for several Explorer and Pioneer satellites. Both American Telephone & Telegraph and General Electric have proposed communication systems using satellites in orbits of only 6,000 to 8,000 mi. altitude.

Umbaugh May Seek New Assembly Site

New York—Fairchild Stratos Corp., upheld by arbitrators in its contract dispute with Umbaugh Aircraft Corp. over assembly of the Umbaugh 18 autogiro, said last week it was willing to discuss new contract terms with Umbaugh "at any time."

American Arbitration Assn. decided in favor of Fairchild in the company's dispute with Umbaugh (AW May 22, p. 33), stating that Fairchild was entitled to refuse further to perform under the 1959 contract, and to regard the contract as no longer in effect.

It appears probable that Umbaugh will seek a new assembly site rather than agree to any substantial cost increase resulting from a new contract with Fairchild. An Umbaugh spokesman said that the company was investigating several locations in Oklahoma and Texas for U-18 assembly.

One site under consideration, the Shawnee Industries facilities formerly used by Jonco Aircraft Corp. in Shawnee, Okla., was acquired last week by Thiokol Chemical Corp. Component parts for the aircraft, originally scheduled for initial delivery to Hagerstown, Md., early this month, are being delayed pending final assembly site selection by Umbaugh (AW Apr. 17, p. 34).

A Federal Aviation Agency spokesman said that additional U-18 technical data is required prior to commencement of certification flight tests.

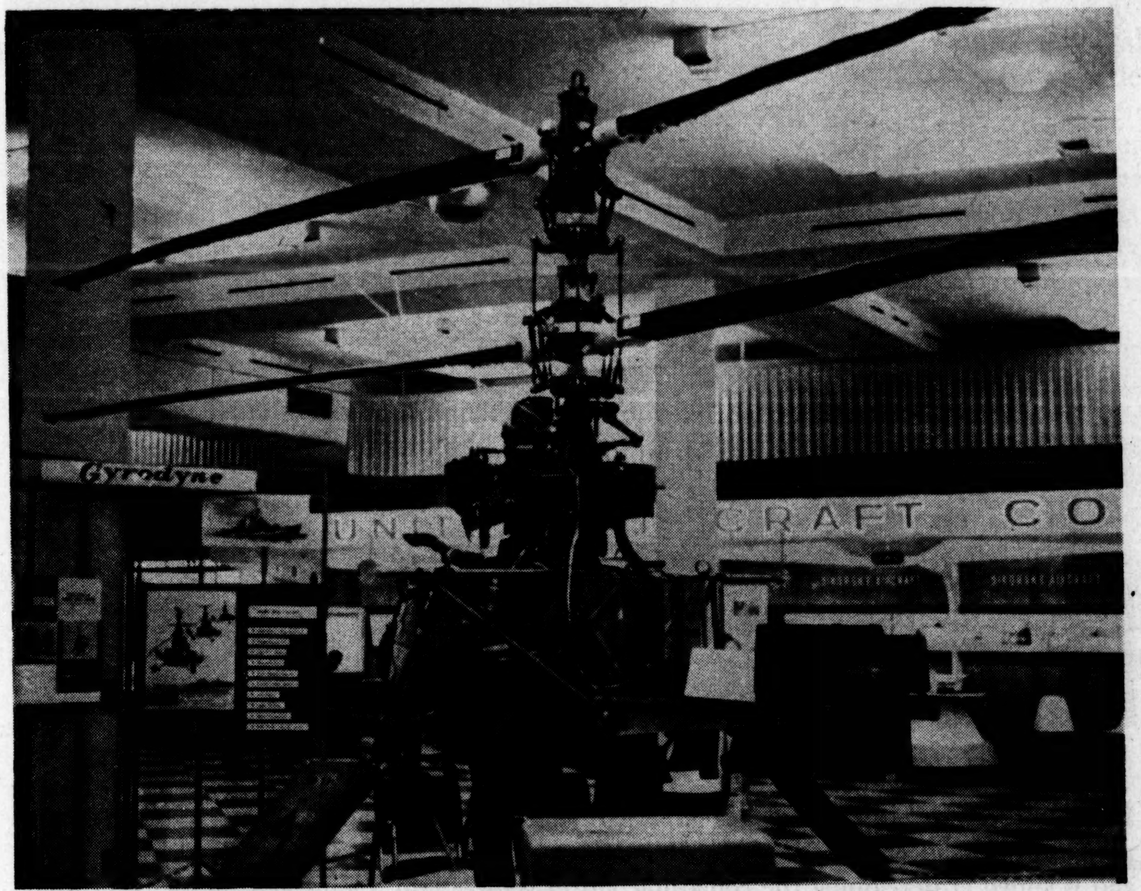
NA.39 Mk. 2 Version

London—Blackburn Aircraft is developing a Mk. 2 version of the Buccaneer NA. 39, fitting it with Rolls-Royce Spey turbojet engines to give the low-level naval strike fighter supersonic capability on the deck (AW Nov. 28, 1960, p. 23).

New engines produce 10,100 lb. thrust, against the 7,000 lb. generated by de Havilland Gyron Juniors used in the Mk. 1 version now in production. Spey is a development of the RB.163 engine earmarked for the de Havilland Trident three-jet transport and the BAC 111. Rolls now has five development engines running and the first two will fly in August on an Avro Vulcan bomber.

NA.39 is equipped for boundary layer control on flaps and ailerons, using about 12% of engine air for this purpose. Blowing reduces approach speed by about 15 kt. Spey fits this design need (AW Feb. 13, p. 23).

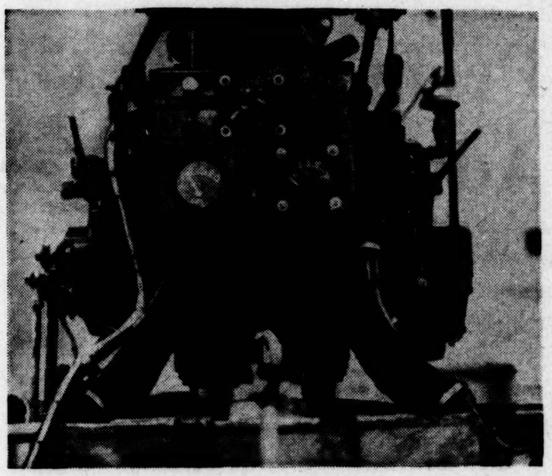
New engines will allow an increase of about 2,000 lb. from present basic weight of 25,310 lb. and still maintain the same range. Maximum speed will be increased by 35 kt. and combat ceiling raised by 8,000 ft.

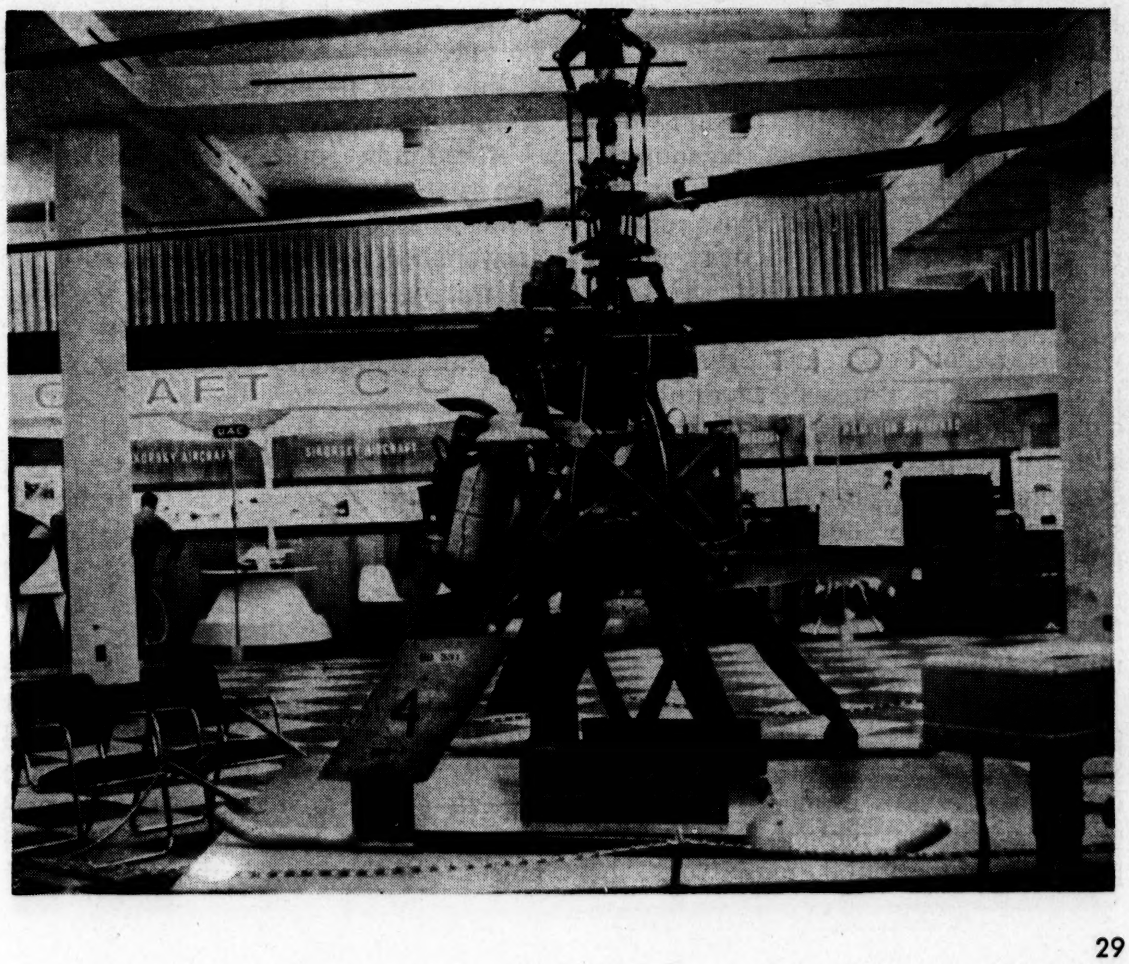


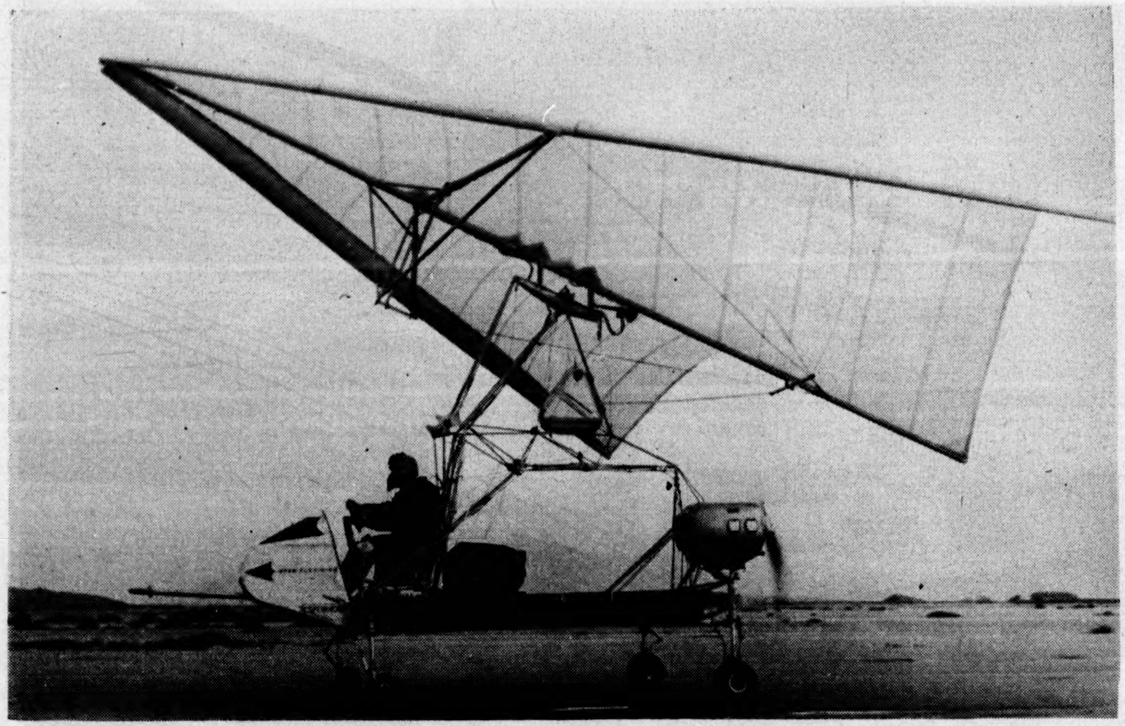
Gyrodyne DSN-1 drone helicopter has fiberglass stabilizing fins and fuel tank.

First Photos of DSN-1 Drone Helicopter

Gyrodyne Corp. of America's DSN-1 drone helicopter, developed for the Navy as part of its DASH (Destroyer Anti-Submarine Helicopter) weapon system, has made 38 successive landings and takeoffs, and 22 flights from the destroyer USS Hazelwood. Coaxial rotor configuration was developed by company for its earlier XRON Rotorcycle. Powerplant is a Porsche automotive engine. Torpedo is slung between skid gear under protruding forward beam. Serial number 1004 indicates this is fourth drone in development quantity. Engine and transmission oil pressure and temperature gages are at right.







Ryan Begins Flex Wing Flight Tests

Flight tests have been started on an experimental Rogallo wing airplane by Ryan Aeronautical Co. Called Flex Wing by Ryan the program is jointly financed with the Army and is aimed at developing the collapsible airfoil vehicle into a light and inexpensive multimission battlefield aircraft. Cords and nylon straps between the keel and leading edges prevent the fabric wing from settling into propeller during ground operation. Ryan is also conducting a study of use of the Rogallo wing in conjunction with land recovery of both Saturn and its S-II upper stage under a six-month contract with the National Aeronautics and Space Administration (AW Feb. 6, p. 35).

Perfection of Orbital Rendezvous Advances Project Saint Timetable

Washington – Defense Department expects to orbit the satellite inspector (Saint) within two years as a result of stepped up effort to perfect orbital rendezvous techniques (AW Nov. 14, 1960, p. 26).

Dr. Harold Brown, director of defense research and engineering, told the House Science and Astronautics Committee that the orbital rendezvous envisioned under the Saint project "might be as little as a couple of years off."

He said the military at the moment is concentrating on developing an unmanned satellite to orbit close enough to another satellite to identify it but not to lock onto or board it.

The U. S. satellite would be equipped with television, radar and other instruments to enable it to send identification data to ground stations. Ultimately, he added, "manned inspection or the use of more complex unmanned inspection schemes might be necessary." He said the Pentagon is coordinating its orbital rendezvous activities with those of the National Aeronautics and Space Administration.

Milton W. Rosen, NASA deputy director of launch vehicle programs, said the agency plans to step up the orbital rendezvous program. The bulk of any additional money Congress appropriates for orbital rendezvous, he said, would be used to design and develop a system for capturing a target vehicle "if you were within say a mile of it."

One possible way to do this, Rosen added, is to home in on the target vehicle and then reach it under propulsion.

Another method now being studied, he said, is to hook onto it by shooting a line over it—much like the rescue techniques used by ships.

Asked how much money he would like to see invested in NASA's orbital rendezvous work in Fiscal 1962, Rosen answered $8 million, compared with the $2 million requested by the Kennedy Administration in its first review of the Eisenhower budget.

Critical Need

The critical need now, he said, "is a very strong program in technology." The development of the actual hardware must await the perfecting of the orbital rendezvous techniques, Rosen said.

He predicted chemical rockets will be used initially for orbital rendevous but would be followed shortly by solid rockets. By 1970, Rosen said, space officials expect to have electric propulsion available. He said electrical propulsion "is very much more efficient."

House Investigators Cite Overcharges

Washington—Comptroller General Joseph Campbell last week presented the House Armed Services Investigating Subcommittee with a long item-by-item listing of aeronautical replacement spare parts for which he alleged contractors have charged the government dollars instead of cents.

Rep. Edward Hebert (D.-La.), the subcommittee chairman, summed up the situation as "a wonderland of waste."

The two major reasons for the excessive pricing, Campbell told the subcommittee, were that prime contractors added a substantial layer of profit onto items wholly produced by subcontractors and that the military services passively used sole-source procurement when competitive bidding was possible.

In one instance related by Campbell, Air Force, by mistake, obtained a competitive bid of about half the cost on an item it had planned for sole-source procurement from its old supplier. This concerned "lockfoam parts kits."

"The justification for sole-source procurement stated that the drawings and specifications necessary to allow advertised procurement were not available and that a single manufacturer would be the only firm solicited, because it was the only known source with the product knowledge and capability to furnish items acceptable to the Air Force," Campbell reported.

"Although it was the intent to solicit a proposal from the previous supplier only, requests for proposals were inadvertently forwarded to several Air Procurement Districts," he continued. The result, according to Campbell, was that a new supplier submitted a unit price of $31.79, compared with $72.15 by the old supplier.

Nuts previously procured from a sole source at $1.83 were obtained for 35 cents. Bolts dropped from 28 cents each to 11 cents; another type of bolt, from $2.59 to 12 cents; and still another bolt, from $9.36 to 89 cents. Vortex generators went from $7.42 to 92 cents. Bracket assemblies dropped from $11.11 to 88 cents.

To illustrate the middle-man earning of prime contractors, Campbell used these examples, showing the difference between the subcontractor price and the price to the government:

- **Air Force.** Bearing, 56 cents and 69 cents; armature, $16.69 and $35.28; helical gear, $46.84 and $70.30.
- **Navy.** Lock, fuel nozzle combust, one cent and 37 cents; bolt, 90 cents and $6.83; seal, $11.31 and $28.05.
- **Army.** Bearing, $63.07 and $92.18; gage, $70.50 and $94.45; bolt, $35.30 and $52.51.

Symington Backs Defense Censors

Washington—Secretary of Defense Robert S. McNamara's plan to close doors on the release of information won a convert on Capitol Hill last week: Sen. Stuart Symington (D.-Mo.), former Air Force secretary.

"Apparently there is now to be a real effort to at least curtail the steady stream of unilateral propaganda emanating from the various military installations supported by all three services, in this country and around the globe," Symington declared in a speech to the Senate.

The statement followed release of testimony before the Senate Armed Services Committee regarding Navy's former and present position on mass bombing. When Defense Department, at first, deleted the testimony from the record, Symington charged that the action was "for public relations reasons only" (AW May 22, p. 23).

In the course of the released testimony, Symington, after reminding Adm. Arleigh Burke, chief of naval operations, that Navy in 1949 had opposed USAF's B-36 program because it entailed mass bombing, observed:

"The Polaris is certainly much more of a city-destroying weapon. . . . So what now occurs to my mind is that there may be some change in your position because there has been some change in who has what weapon."

Adm. Burke replied: "There has been a change in position, but not for that reason. I think it is commencing to be realized now not only by people in the United States, but by the whole world, that you cannot have a general nuclear war and not have vast devastation, and if anybody can win in a war like that it will be winning over a country that has been very greatly devastated.

"If we go to war in a general nuclear war with Russia, there is no way on God's green earth that Russia can avoid very heavy destruction, millions and millions of people, and the same thing is true here. We would take lots of casualties. . . ."

Meanwhile, Rep. John Moss (D.-Calif.), chairman of the House Government Information Subcommittee, assured that his group would continue to be as watchful over the release of all defense information that the public has a right to know as it was under the former Republican Administration.

Commercial Satellites

Washington—Federal Communications Commission said last week that a joint commercial satellite system that includes international communication common carriers but excludes aerospace companies would best serve the public interest. It invited common carriers to meet June 5 to explore plans for "early establishment" of a system. General Electric, Lockheed, RCA and a number of other aerospace companies have sought to take part in a joint venture with common carriers.

Meanwhile, President Kennedy asked $50 million more to expedite civil communications satellite development (see table, p. 25), and FCC issued preliminary recommendations on allocation of frequency bands for space communications. FCC urgently requested comments from industry by June 23 on its initial views and said it will initiate a separate rulemaking proceeding on location of earth stations for space communications. Its modified views, based on the June 23 replies, will be recommended to State Department as U. S. policy in negotiating with other nations.

National Aeronautics and Space Administration also announced it has begun negotiating with American Telephone & Telegraph for rapid development of a plan to launch AT&T's experimental communications satellite.

Air Temperature Cuts F4H's Record Speed

New York—McDonnell F4H-1's record breaking transcontinental flight of 2 hr. 48 min on May 24 did not match computed expectations due to upper air temperature of −50C which was warmer than ideal.

Participating in the Bendix Trophy race along with three other F4H-1s, Navy Lt. Richard Gordon, Jr., pilot, and radar intercept officer Lt. J. G. Bobbie R. Young, number three team, crossed the finish line at Brooklyn NAS, N. Y., first, with an average ground speed of 871.38 mph. for the 2,445.9 stat. mi. route from Ontario, Calif.

First three F4Hs flying non-stop broke the previous record established by USAF Lt. Gustave Klatt in a McDonnell F-101C in November, 1957. Second in the race was team number two flown by Lt. Cdr. Scott Lamoreaux with a time of 2 hr. 57 min. Third was team number one flown by Cdr. Julian S. Lake with a flight time of 3 hr. 3 min. The fourth F4H, piloted by Lt. Cdr. Paul Spencer, was unable to make its third refueling due to tanker trouble and was forced to reduce to subsonic air speeds in order to complete the flight nonstop.

The contesting aircraft made in-flight refueling contact with Douglas A3D tanker teams over Albuquerque, N. M., St. Louis, Mo. and Pittsburgh, Pa. Refueling was accomplished at 33,000 ft. at maximum tanker speed near Mach .8. The F4Hs fueled with a 600 gal. external belly tank. Carrying two sidewinder missiles each, the aircraft were flown at maximum cruise with afterburner at just under Mach 2 at an altitude of approximately 50,000 ft. Ground control intercept radar was used during the flight to aid navigation and to facilitate tanker rendezvous.

In Connecticut the same day, Sikorsky's HSS-2 twin-turbine helicopter claimed a second world speed record for this helicopter when it flew 174.9 mph. over a 100-km. (62-mi.) closed circuit course. The current official 100-km. record is 167.09 mph. set by a Russian Mi-6 on Nov. 21, 1959. On May 17 the HSS-2 had claimed a record of 192.9 mph. over a 1.86-mi. straight line course (AW May 22, p. 34).

News Digest

Final attempt to use a Juno II as a space launch vehicle failed May 24 in a malfunction traced to the upper stages. Failure was the second try to orbit an ionospheric beacon to sample the atmospheric structure. In the 10 launchings of Juno II, five were successful. Three failures were traced to upper stages, one to guidance and one to attitude control.

Super Sparrow air-to-air missile program to provide substantial increases in performance of current Sparrow IIIs has been initiated by Navy Bureau of Weapons with award of $675,000 development contract for a new motor to Rocketdyne's Solid Propellant Operations, McGregor, Tex.

Crash of Cessna Skyhook factory demonstration helicopter near Midland Air Park, Tex., is under investigation by team of Federal Aviation Agency and factory personnel. Sole occupant, Oliver M. Hopkins, Cessna rotary wing sales specialist for western U.S., was killed. Crash occurred a few minutes after Hopkins had departed Midland where he had refueled. Indications are that the main rotor blades contacted the tail rotor while the Skyhook was at approximately 500-ft. altitude.

First technical report on bioastronautics data from the MR-3 ballistic flight of Astronaut Alan B. Shepard will be given June 6 in all day session at the new State Department Auditorium in Washington.

General Electric Co. appointed Robert J. Brown general manager of the company's Heavy Military Electronics Department, where he formerly served as marketing manager.

AIR TRANSPORT

Eastern Renovates Passenger Services

Airline aims at faster check-in and baggage handling, stresses on-time departures and in-flight service.

By Glenn Garrison

New York—Eastern Air Lines, convinced that airline survival in today's competitive markets depends largely on a reputation for passenger service, is completing the first phase of a program to promote its revamped service functions.

Eastern acknowledges it had a long way to go in overcoming a previous poor reputation in many service aspects. Under new president Malcolm MacIntyre, however, a complete renovation of the passenger service function has taken place and the airline now is in the midst of a large-scale advertising and promotion campaign to push its new service image.

Sections of four departments were consolidated in February, 1960, under a new customer services department headed by Vice President Robert L. Turner, and its program has included the following major improvements:

- **Individual attention** to the passenger through "front of the counter coverage," including newly appointed customer service representatives at major terminals to assist with individual passenger problems.
- **On-time departure record** which last month reached a new high with 76.3% of 39,909 flights departing on time and 89.6% departing within 15 min. of schedule.
- **New check-in procedures,** including express check-in counters, with the aim of speeding the customer's passage to his aircraft.
- **Baggage handling speedup** through expansion of equipment and personnel and wider use of self-claim facilities and carry-on procedures.
- **In-flight services revamping,** including a new food service organization and policy, and changed procedures for hiring, training and supervising flight attendants.

Eastern's previous standing regarding passenger service added to the particularly tough competitive position the airline faces: multiple competition over its prime routes, and its present relative scarcity of jet equipment. Surveys by Eastern itself, its advertising agency and others indicated that Eastern ranked far down the list in some service categories. Major complaints included the lack of personalized attention, baggage-handling problems, ticketing delays, and food service which left something to be desired.

With its intense new program, Eastern hopes to improve its service image so as to compete more strongly for passengers in a market where schedules, airplanes, and fares of airlines on the same routes will be comparable, and where the passenger's decision will depend on which airline he feels will give him the best service as an individual.

In Eastern's case, according to an official of the airline, there has been a "second generation fresh look at things" with the advent of MacIntyre as president. Passenger service functions had been scattered around the organization—reservations under the sales department, for example—but they are now consolidated. Actually there have been three major steps in Eastern's evolution: from a primarily mechanical, operational orientation and responsibility, to an equal emphasis on sales, and now to the new emphasis on the third major area, passenger service.

The major campaign to promote Eastern's new service image began in March and includes advertisements which stress the basic service improvements. About 50% of the airline's $1.25-million advertising budget for March, April and May was devoted to this campaign, as opposed to Eastern's traditional travel-type advertising.

Eastern Omits Dividend

New York—Eastern Air Lines advised stockholders that the quarterly dividend on common stock had been omitted because of a strike, the need for cash to finance the carrier's jet program, and "unfavorable profit opportunities under the present overcompetitive and underpriced conditions in the industry."

Eastern had paid a quarterly 25 cent dividend since Nov. 15, 1955, and an additional annual dividend of 2% in stock has been paid concurrently with the year's final quarterly dividend since Dec. 15, 1956.

Turner, who went with Eastern specifically to take the new customer service chief job after serving as vice president-traffic with the Air Transport Assn., told Aviation Week that his basic organizational setup was completed last August. But the promotional campaign, he said, wasn't begun "until we had something to back it up."

Improvements in service have already shown results, Turner said, by the only available yardsticks—higher employe morale, and good public reaction as expressed in letters to the company.

The new department took over some of the functions of each of four existing departments. From traffic it absorbed reservations and city ticket offices; from ground operations, almost all ramp operations except refueling; from maintenance, all aircraft cleaning functions except wash rack cleaning during major maintenance periods; from flight operations, cabin service including attendants and catering.

Three main divisions of the new department, and their principal functions, are as follows:

- **Airport services** handles ramp procedures and the administration of airport ticket counters and passenger handling. This division is engaged in three major projects—speedup of incoming baggage, on-time departure record, and streamlining of check-in procedures. According to Turner, future equipment designed into the terminals will be the long-range solution to baggage handling, but Eastern couldn't wait for that development. In the meantime, improvement has been made by "brute strength"—addition of more personnel, carts, tugs and the like and boosting the morale and efficiency of the handlers. As an example of the improvement, Turner said that at La Guardia in April the slowest first-class bag arrived at the claims counter 4½ min. after arrival, compared with an average of at least 12 min. previously. Passengers arriving at the claim area, Turner said, have been, in some cases, waiting for baggage that already had arrived (not being accustomed to such speed) and it has been necessary to install signs asking the passengers to see if their bags are already there.

In the on-time campaign, there has been a much broader use of spare airplanes. Equipment is kept out of scheduled service or routine maintenance and spotted at key locations to take over if necessary to avoid delays. These airplanes are not committed to charter flights. Another major effort has been made in setting up control centers at major stations. These centers follow a checklist of items needed for departure and coordinate the entire process.

For example, if a ramp agent finds a dirty rug in the scheduled aircraft he notifies the center, which calls maintenance for a replacement. Or if the caterer has forgotten that particular flight, the center discovers it from the checklist and calls for action. Eastern has invested heavily in communications to go with the control center concept: radios, for example, in tugs, gas tenders, catering trucks so there can be virtually instantaneous communication from center to all ramp activities.

Third Major Project

The third major airport services project, check-in streamlining, has involved creation of express check-in positions for passengers with tickets at all major terminals. Other short cuts have been instituted in the check-in of baggage and the ticketing of passengers. For example, checking of reservations lists has been eliminated: if the passenger says he has a reservation, he is presumed to have one. The whole effort is devoted to moving the passenger and his baggage quickly from terminal entrance to aircraft gate with a minimum number of stops or no stops at all.

- **Traffic services** also works on the check-in project. It also handles reservations, space control, and city ticketing offices. A major effort has been in cutting telephone answering times. Formerly, the goal was to answer 70% of incoming calls within 15 sec.; this goal has been increased to 80% and, Turner said, is generally being met or bettered.
- **In-flight services** has revamped the flight attendant and catering programs. It now handles the initial selection of stewardesses: customer service representatives accompany personnel people in recruiting interviews. The stewardess school has been overhauled and is now headed by a woman instead of a man. Such details as makeup and hair styling now meet more rigid standards. Turner says "the girls are now nicer looking and better trained." Another change was the splitting of the stewardesses into groups under the control of supervisors with more authority, providing better job control and communications.

In the catering area, a new supervisor is in charge and policies have been radically altered. Among other things, the number of catering stations has been reduced and better caterer controls have been established. A wider selection of in-flight meals is offered, and the program actually has resulted in substantial savings in money.

In addition to the work of its three divisions, the customer service department handles some staff functions such as publications, supervisor training, quality control and statistics. The department also comes up with basic thinking for such projects as Eastern's "airbus" and "air-shuttle" services (AW May 8, p. 40).

Among the projects of the department currently is a study of the effect computers may have on future activity. First, what the computers are going to be able to perform; and second, what effect their use will have on personnel. Eastern is trying to anticipate employe relocation or elimination needs as a result of computer use, and as far as possible to handle the situation by normal employe attrition.

An adjunct of the customer service drive is stimulation of employe incentive and morale. For example, Eastern has instituted "presidential citations" for accomplishments "above and beyond the call of duty." The winners are nominated by passengers or fellow employes, awarded a silver cup and given a weekend of entertainment in New York. First of the four-times-a-year ceremonies was held last December. Sample winners: two flight attendants on a San Juan-Idlewild flight canceled at Richmond, Va., because of weather, who accompanied the passengers on a chartered bus to New York and performed a number of unusual services **for the passengers.**

Board Asks FEIA-ALPA Merger

Washington—Merger of the Flight Engineers International Assn. with the Air Line Pilots Assn., was the major recommendation last week of a special presidential commission appointed to investigate the engineers' simultaneous shutdown of seven airlines last February.

At the same time, a separate presidential emergency board reviewing the cause of a 47-day strike of International Assn. of Machinists flight engineers on Northwest Airlines, last January, recommended that the airline employ three-man crews on turbojet equipment; decide its own crew member qualifications and preserve the existing job priorities of presently employed flight engineers.

In addition to the merger proposal, the presidential commission under Chairman Nathan P. Feinsinger urged that all parties to the dispute commence negotiation within 30 days on the following points:

- **Turbojet flight crews** on all airlines should be limited to a three-man operation. On carriers using a four-man crew, the commission said, flight engineers should be retained and not required to take pilot training. However, the report stipulated, the engineer may choose whatever option the airlines' offer, such as severance pay, early retirement or a suitable ground job.
- **Crew reduction** should provide that the third position will involve the present functions of the flight engineer and "some kind of piloting duties." Feinsinger remarked that four-man crews were an "accident of collective bargaining" which "should stop right now." He later added that while Federal Aviation Agency regulations recognize the importance of flight engineer functions, they do not stipulate that only FEIA members can perform these duties.
- **Assurances from ALPA** that it will not "in the near future" seek any further representation rights from other airlines, similar to the elections now in process at United Air Lines under the National Mediation Board, should remove FEIA's concern over any jeopardy of their job security by an expansion of this process. Feinsinger noted that representative election ballots on the United issue are scheduled for May 26 counting. As an alternative, but not a "condition of settlement" of the overall controversy, the report recommended that FEIA and ALPA "merge, consolidate, or take other appropriate cooperative action" to settle the issue.
- **"Joint Committee** on Inter-Union Cooperation" should be established by the two unions.
- **Should Western Air Lines** continue its refusal to rehire striking engineers, the commission will ask the carrier to agree to the appointment of a neutral party authorized to make recommendations in the matter after hearing both sides of the case.
- **Initial bargaining** on all issues should begin immediately and take place in Washington under the auspices of the commission. If the parties fail to commence negotiations on the report recommendations within a 30-day period, the commission then plans to reconvene and recommend such further action "as may then seem desirable."

Release of the report also included a strong message from President Kennedy who urged its full acceptance and emphasized that, "one thing is clear: we cannot have further strikes over these disputed issues. There can be no legitimate excuse for interruptions of service now that these commisisons have marked out the areas of fair and reasonable settlement. The public deserves, expects and demands that such settlements be reached."

Port Authority Seeks Permission to Open Newark Airport to Jet Traffic

New York—Port of New York Authority's long-expected move toward opening Newark Airport to jets (AW May 22, p. 33) highlights the dilemma of an airport operator with strong local opposition: accept jets despite the opposition, or see your airport relegated to a minor role as services are shifted elsewhere.

The Port Authority has announced it may grant requests by American and United to begin such service about June 11, with initial Newark-Chicago schedules. But there are still political hurdles to be faced, and observers do not expect that the target date will be met.

New Jersey Governor Robert Meyner has not said yes or no to the requests, but plans to appoint his own noise consultant to study the situation. Some delay is expected. However, it is generally believed that jets will be operating on schedules at the airport in the near future. Meyner has the authority to veto any such Port Authority action if he wishes.

Port Authority's View

The Port Authority advised Meyner that Newark ". . . cannot be considered a first-class modern air terminal today or at any time in the future if its operations are limited to propeller-type aircraft." Newark is one of the few of the 30 most populous cities in the U. S. without jet service, the agency said, and as a result scheduled plane movements decreased 5.5% in 1960. "If this trend is allowed to continue," the Port Authority said, "Newark Airport will be relegated to the role of handling a very small volume of local service to a relatively few close-by cities and towns."

Analysis by its staff has convinced the agency that "the existing family of jets can operate in short- and medium-haul service . . . at takeoff noise levels not greater than, and in many cases less than, that created by . . . piston engined operations."

Jets would operate under Port Authority restrictions at Newark, including specified runways and a 112 perceived decibel noise limit over adjacent communities.

Both American and United plan to operate Newark-Chicago services, American initially with Boeing 720B equipment. United would start off with a 720 service, add Caravelles shortly thereafter. A number of airlines have been using Newark for jet diversions from Idlewild, which resulted in 230 jet movements at the airport last year. The planes are ferried back to Idlewild since no revenue departures are permitted.

First carrier formally to request jet schedules at Newark was Delta, which applied last year without success. But Delta has no immediate plans to serve Newark with jets even if the airport is opened up to them. Delta has nine Convair 880s, with three more to be delivered later this year, and its fleet presently is occupied elsewhere. It has a new route to serve as a result of the Southern Transcontinental Case. However, the airline says it constantly reevaluates requirements at various traffic points.

Among the factors which could lead to Delta's going into Newark with jets is the United-Capital merger, which would involve present Capital routes from Newark which compete with Delta's. Another factor is possible action by Eastern, another competitor at Newark.

Eastern has no immediate plans either to go into Newark with jets. The carrier is short of jet equipment at the moment, but first deliveries of 720s are expected this fall. Eastern operates the most schedules at Newark.

TWA, also without an excess of suitable equipment, doesn't plan an early request for scheduled Newark jet service. But the airline would like to operate diverted flights out of Newark as revenue departures. It asked permission to do this last year and was refused.

Braniff's Controlling Stock Changes Hands

Dallas—Working control of Braniff International Airways has passed into the hands of four top executives of Texas Instruments, Inc., Dallas-based electronics manufacturer, who purchased 1,006,000 shares of 2,948,118 shares of common outstanding from Sen. William A. Blakley (D.-Tex.).

Price of the transaction was approximately $13.5 million, covering some 522,000 shares owned outright by Sen. Blakley and 484,000 shares of the Blakley-Braniff Foundation, the latter chartered to carry out educational, religious and public welfare projects.

The four purchasers, Erik Jonsson, Texas Instruments, board chairman; Eugene McDermott, executive committee chairman; P. E. Haggerty, president, and Cecil Green, vice president and honorary board chairman of Texas Instruments' wholly-owned subsidiary, Geophysical Services, Inc., emphasized that they considered the purchase a good personal investment on their part and that it was not related in any way to the electronics firm.

As spokesman for the purchasers, Jonsson said that they did not contemplate any changes in Braniff policy or personnel as a result of the change in ownership of the largest single holding in the airline, although indications were that they would play an active role in the airline's future. Sen. Blakley has resigned his positions as one of Braniff's 15 directors and as a member of its seven-man executive committee. No announcement was made of filling these vacancies at the time of the announcement of the stock sale.

Blakley, who has been associated with Braniff since the 1930s, is campaigning to fill the unexpired term of Vice President Lyndon Johnson in the Senate. The Senator said that he disposed of his Braniff holdings so that he could devote more time to his political post, terming stories to the effect that he liquidated his holdings because he was in need of funds as "pretty sorry information."

American Requests Restraining Order

Washington—American Airlines has taken legal action to halt a Civil Aeronautics Board decision in the Southern Transcontinental Case, which the carrier contends will reduce its annual net profits by $15 million (AW May 22, p. 46).

In a petition filed with the U. S. Court of Appeals for the District of Columbia, the airline asked that the June 11 effective date of the Board order be stayed until 30 days after the CAB has ruled upon American's petition for reconsideration. The court has set June 1 as the date for a hearing on the stay request, American attorneys said, adding that if it is granted, a full judicial review of the CAB decision will be requested.

The extension of the Florida and Texas routes of Delta Air Lines and National Airlines to the West Coast, along with the abandonment of all interchange agreements between the two carriers and American, would damage American's ability to earn dividends or pay interest on long-term debt, the attorneys said.

Granting of a stay by the court would "assure continuance of the status quo" until the board has ruled on the petition for reconsideration, all parties have had an opportunity to consider the answer and the possibility of following legal action, and the court has had a chance to consider such requests, all of which would be impractical before the June 11 effective date of the Board order, American said.

BOAC Scores Cunard Eagle Route Bid

London—British Overseas Airways Corp. last week contended that granting an independent operator—Cunard Eagle Airways—a license to fly a parallel route across the North Atlantic will "strike at the very heart of the BOAC enterprise."

In hearings before Britain's new Air Transport Licensing Board, Cunard Eagle, a subsidiary of Cunard Steamship, Ltd., countered that the potential increase in passengers along the disputed route is "absolutely limitless."

The airlines are clashing over the first of a series of applications by independent airlines for routes which previously have been flown only by BOAC and British European Airways, the other state-owned carrier (AW May 22, p. 34). Next round starts June 21 when British United Airways, the largest independent, tangles with BEA for a number of European and African routes.

Authority to apply for the routes came last Mar. 31 when Parliament approved a new Civil Aviation (licensing) Act of 1961, opening routes to competitive British airlines.

BOAC is opposing Cunard Eagle's application in what Basil Smallpeice, managing director, said is "in the strongest possible terms." He told the Board:

"BOAC sees in this application a potential challenge to the position which it has built up over the years on this North Atlantic route by sustained effort and research, capital investment, operating technique and manpower."

Cunard Eagle's primary interest is in daily service to New York City, starting next spring after delivery of two Boeing 707-420 jet transports now on order. The application also asks service to Montreal and Toronto. BOAC now flies 64 services a week to New York and Canada, using Boeing jets.

Basically BOAC's opposition to Cunard Eagle rests on the following premises:

- **There is no need or demand** for another British carrier on the North Atlantic.
- **Similar service would be** a "wasteful duplication" of BOAC's efforts.
- **Service would cause** a "material diversion" of passenger traffic from BOAC.
- **BOAC's financial dealings** with the British aviation industry, involving aircraft orders worth nearly $400 million beyond 1963, would possibly be jeopardized by entry of a competing British carrier.
- **Addition of a second British airline** will involve renegotiation of bilateral agreements with the U.S. and Canada, and could reflect on pooling agreements now in force between BOAC and U.S. and Canadian airlines.

Speaking for BOAC, Henry Fisher, the airline's counsel, admitted that under current agreements with the two governments, the United Kingdom is allowed to put another British carrier on the North Atlantic, but he warned that this could be "prejudicial to BOAC's interests in traffic rights, relative to intergovernmental agreements, by weakening the United Kingdom's bargaining position in future bilaterals."

Fisher claimed that unless Cunard Eagle's North Atlantic passenger traffic came from the market now held by other operators, it would inevitably take business away from BOAC. About 40% of the traffic now is held by Trans World Airlines and Pan American World Airways.

Fisher testified: "Since 1946, BOAC has built up transatlantic service from nothing and now Cunard Eagle seeks to come in to share the prize without bearing any of the heat and burden of the day."

BOAC struck at Cunard Eagle's financial relationship to its parent company, Cunard Steamship, which has applied for about $50 million in government loans and grants to build a new "Queen" ocean liner. Cunard Eagle is spending more than $12 million of its own money to buy the two Boeing jets.

Fisher asked Sir John Brocklebank, Cunard Steamship chairman, if it would be a fair description that Cunard wanted to "back both horses—the aircraft with their own money and the ship in part with other people's."

Cunard Wage Policy

London—One aspect of labor relations entered into the BOAC-Cunard Eagle Airways hearings on a North Atlantic Route, when the British independent said it would match wages and contract benefits for jet pilots negotiated with British Air Line Pilots Assn. by BOAC.

Cunard Eagle's contract with pilots now includes aircraft ranging from Douglas DC-6s to Bristol Britannias. BOAC replied: "If the board were to grant a license, and would put a condition in the license to that effect, that ground of objection goes."

In another move, the BOAC Shop Stewards Committee, representing some 4,000 engineering and maintenance workers, opposed any "further encroachment" by independent airlines and said the applications to fly on BOAC and BEA routes were a "serious threat" to the nationalized airlines.

Brocklebank replied that the "ship problem came up long before we thought of buying Eagle, and we did not contemplate flying."

Harold Bamberg, Cunard Eagle chairman and managing director, also told the Board that it is "well within the resources of Cunard either to provide the cash or by way of raising finance to find the $14 million involved in the Boeing purchase." He claimed that the question of government aid for a new Queen liner could not be related to Cunard's air activities.

In posing BOAC's case against Cunard, Fisher told the board that BOAC and its predecessors had pioneered a world-wide network at a vast investment of public money which now was at risk. Capital investment today is about $400 million. By 1966, capital investment, considering aircraft orders now in effect, will stand at more than $602 million.

Fisher cited BOAC's orders for 15 Vickers VC.10s and 30 Super VC.10s to take care of additional capacity deemed necessary up to 1967 or 1968. He said "if an independent comes in, the aircraft will be redundant and future profits jeopardized."

BOAC contends that the seat capacity provided by the new airplanes will provide Britain's share of the North Atlantic route by 1966, obviating the need for another flag carrier on the route. The company said it will have 13 VC.10s and 10 Boeing 707s on the North Atlantic in 1966-67.

The attorney emphasized that BOAC has never been a monopoly, in that it has operated on the North Atlantic in an atmosphere of intense competition with 18 operators, 10 of them operating through Britain. He claimed that the intention of the new licensing act was that where BOAC had established routes and a planned future program, the routes were not to be broken into.

Eight foreign carriers now operate through the United Kingdom to the United States under Fifth Freedom rights. They are Air-India, Alitalia, KLM, El Al, Pakistan International, Qantas, Sabena and SAS.

In discussing Cunard Eagle's finances, Fisher noted a section of the act charges the Board to consider "the provision made or proposed to be made against any liability in respect of loss or damage to persons or property which may be incurred in connection with aircraft operated by the applicant."

This brought a sharp rejoinder from Norman Ashton Hill, Cunard Eagle director and company counsel, who said the question of Cunard's finances was "an improper suggestion that it would dodge its obligations to the public." All of Cunard Eagle's operations, he stressed, would be fully backed by the parent company, and a letter to that effect was submitted as evidence.

In putting Cunard Eagle's case for a license, Ashton Hill claimed that "if there is any route in the world which admits of dual participation, this is the one." He pointed to vast population areas at both ends of the North Atlantic service, and the growing wealth of the North American market.

Cunard Eagle, he continued, is "not out to take the cream off the routes that BOAC has built.

"We are out to participate, in the interests of British aviation as a whole, in a route on which the traffic flow, in our submission, is such that it warrants a second British operator."

Traffic Increase

Ashton Hill said the average increase in traffic over the North Atlantic was about 20%: In the past five years, with one exception, this average has been exceeded. In 1960, the increase was 24.7%.

Cunard Eagle, according to Ashton Hill, has the background, staff and will have the equipment to operate the route satisfactorily. Cunard Eagle should be allowed the route, he said, because:

- **Lower fares,** which are inevitable, will stimulate traffic even further.
- **Growing wealth** of the wage-earner in the United States.
- **Cunard Eagle's past experience** on overseas routes, including charters and Britannia service from London to Bermuda.
- **Pan American and TWA** operate in competition with each other and with other foreign carriers, yet the United Kingdom has had but one operator "for legislative reasons."
- **Cunard Eagle will enter** the service with modern jet equipment because it is readily available and is considering the purchase of British-made airplanes in the future.
- **Cunard Eagle has the "full backing** and financial support" of its parent firm, Cunard Steamship, Ltd.
- **Number of passengers carried** on the North Atlantic last year—some three million—was "but a drop in the bucket of the population" at either end of the route.
- **Cunard Eagle has developed** into a major air carrier without any form of subsidy.

Cunard Eagle said it would start its service, if a license was granted, between London and New York City. Application also includes a request for service to Boston, Philadelphia and Washington-Baltimore, in addition to the Canadian cities.

Announcement of the Board's findings is not expected for some months. Both sides have the right of appeal.

Modified Argosy 650 Goes Into Production; Aloha Shows Interest

London—Armstrong Whitworth has started production of a Series 200 Argosy 650 turboprop transport, incorporating a major redesign of the wing structure for a fully fail-safe concept.

Officials said the new model will include a box-spar type wing, to gain the fail-safe concept through broader distribution of wing loads. Present wing is of the mass-spar boom type.

Series 200 Argosy was inspected at Armstrong Whitworth's Coventry plant by Hung Wo Ching, president of Aloha Airlines, and Kenneth F. C. Char, Aloha vice president in charge of operations. Ching said Aloha is "greatly interested" in the Series 200 model and is considering eventual purchase of two airplanes for air cargo service in Hawaii.

Aloha now operates Fairchild F-27 turboprops in scheduled passenger service and last month reached a peak load factor of 64%. The airline has made marked inroads on its sole competitor, Hawaiian Airlines (AW Mar. 21, 1960 p. 43) and attributes much of its success to turboprop equipment. Ching said Aloha will show a profit this year.

Aloha has supported a proposal to establish a state-owned air ferry service connecting the six main Hawaiian islands (AW Feb. 20, p. 37) but the state legislature has turned the proposal down and now is studying possibilities of surface ferries, primarily hydrofoils.

Air Cargo Need

Ching said he is convinced of the value of air cargo service as a boost to the Hawaiian economy and now is undertaking a market survey aimed at Aloha's capabilities when equipped with two Argosies. One possibility is air freighting of dressed cattle from ranches to urban markets, and haulage of fresh vegetables. Aloha also is studying the air-bus plan, to be used in mixed passenger-cargo configuration.

Ching envisions the need for pure jet service on short hauls in the Hawaiian Islands by 1965 and last week inspected the BAC 111 short-haul jet (AW May 15, p. 42). No firm commitments have been made for either the Argosy Series 200 or the BAC 111.

CAB Reorganization Before House Unit

Washington — House Government Operations Committee late last week was expected to report favorably on President Kennedy's plan to reorganize Civil Aeronautics Board so as to allow Board members more time for major policy and planning decisions.

Under the proposed legislation, which is based on a report drafted by presidential adviser James M. Landis (AW Jan. 2, p. 28), the CAB chairman would be entrusted with broad authority to delegate power to decide less complex issues to individual board members, hearing examiners and high-level employes.

Testifying before the House Subcommittee on Executive and Legislative Reorganization, CAB Chairman Alan S. Boyd predicted that the Board would proceed with "considerable caution" in delegating authority. Even though more tasks could be delegated to senior staff officers such as bureau and office heads, Boyd warned that this might make the delegatees unavailable for work that might be even more important.

Boyd offered statistical evidence of the CAB workload over the last five years. This disclosed that about 65% of the Board's time was consumed by adjudicatory and licensing cases; that in about half such dockets, the Board followed the examiner's decision without changing it and that in foreign permit applications, the Board sustained the examiner's decision about 95% of the time.

Asked for a precise example of a subject suitable for delegation, Boyd singled out "use it or lose it" proceedings held to determine whether communities served by subsidized airlines were generating enough traffic. Enunciated in 1957, this use it or lose it policy has been tested, challenged and interpreted, Boyd said, and "we know what it is." As a result, hearings are fact-finding rather than adjudicatory in nature.

Trans Caribbean Orders Turbofan DC-8

New York—Trans Caribbean Airways has ordered a turbofan-powered Douglas DC-8 for delivery next October and has optioned a second DC-8. The airline expects to put the jet into operation on its New York-San Juan run in October.

Price of the initial order, including spares, is $6.5 million. Trans Caribbean is negotiating with other airlines to lease a jet for the summer for use on the route.

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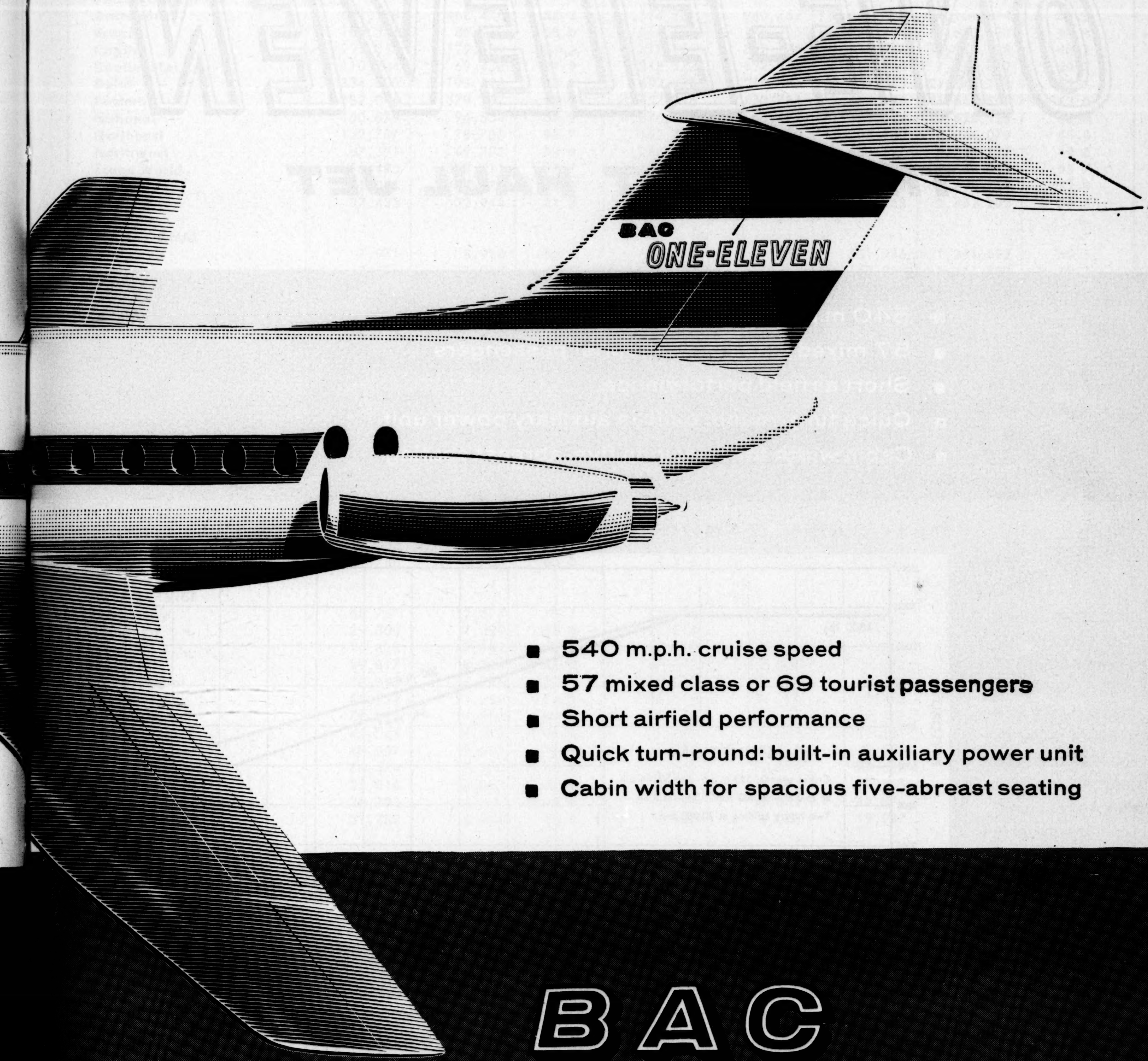

- 540 m.p.h. cruise speed
- 57 mixed class or 69 tourist passengers
- Short airfield performance
- Quick turn-round: built-in auxiliary power unit
- Cabin width for spacious five-abreast seating

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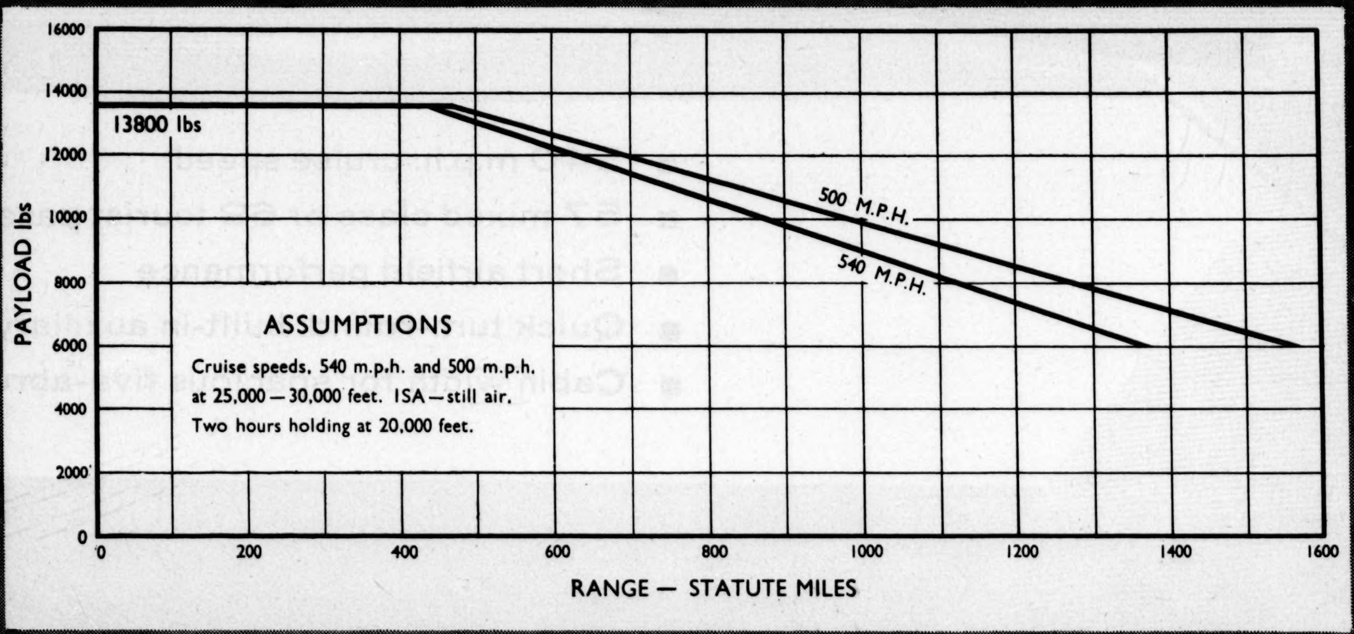
BAC
ONE-ELEVEN
THE SHORT HAUL JET

- 540 m.p.h. cruise speed
- 57 mixed class or 69 tourist passengers
- Short airfield performance
- Quick turn-round: built-in auxiliary power unit
- Cabin width for spacious five-abreast seating

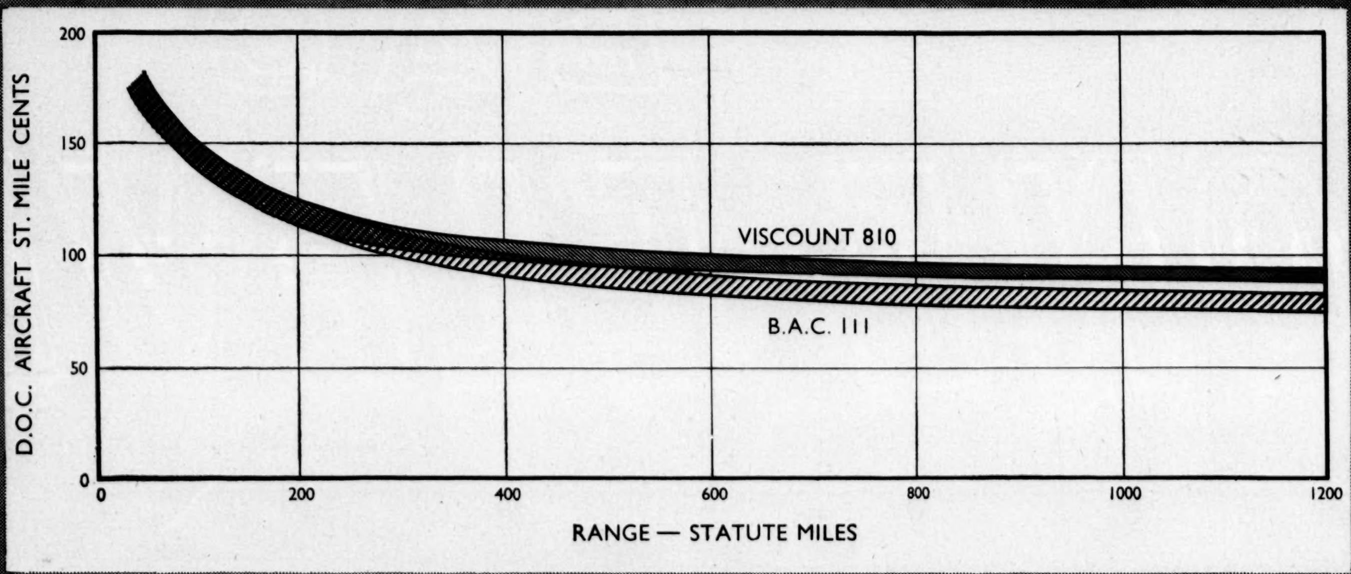
PAYLOAD V. RANGE

The BAC One-Eleven can carry its full complement of 57 mixed class passengers and baggage at 500 mph for stages of 600 statute miles with two hours reserves. It can carry 40 passengers for 1,200 miles



ECONOMICS

These bands cover seven separate methods of costing —ATA (1955), ATA (1960), SBAC and those of four airlines



BRITISH AIRCRAFT CORPORATION

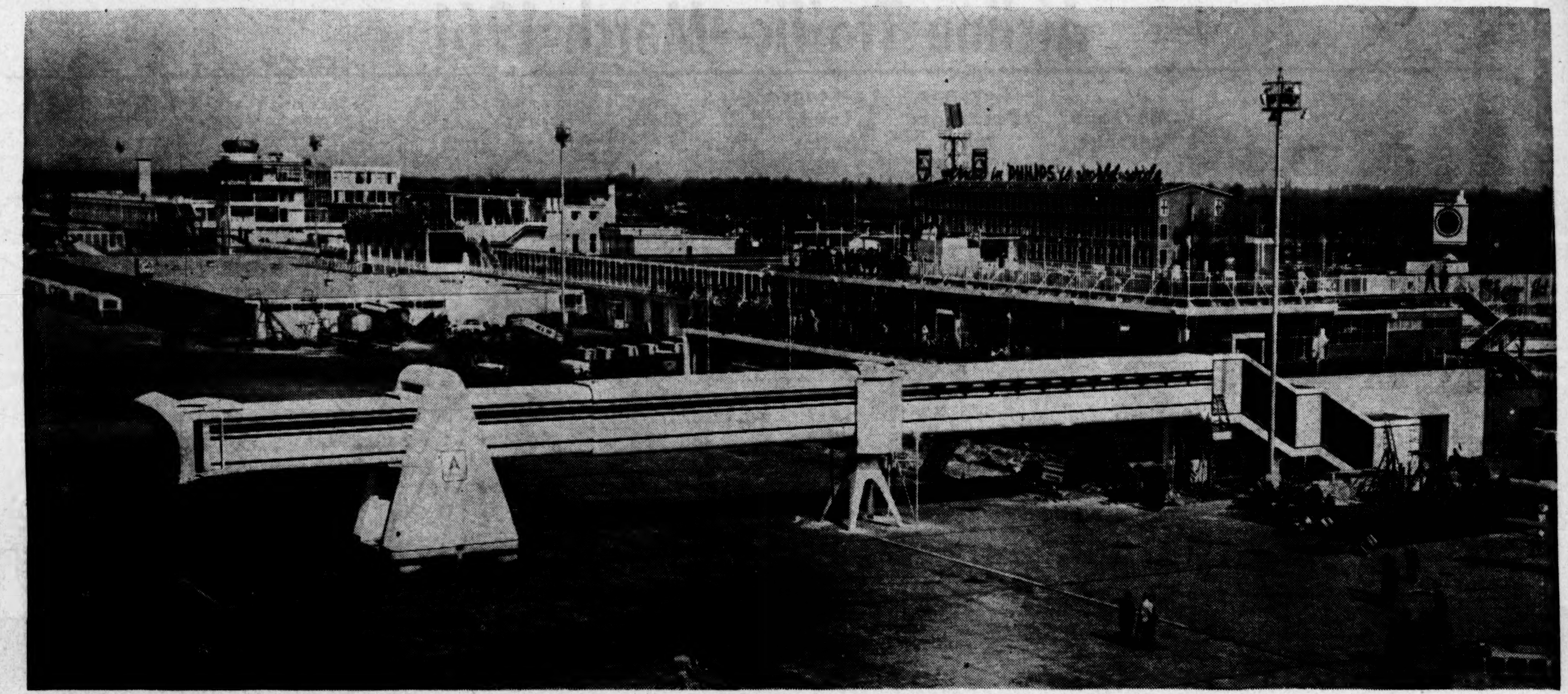
ONE HUNDRED PALL MALL LONDON SW1 ENGLAND

Airline Traffic—March 1961

	Revenue Passengers	Revenue Passenger Miles (000)	Passenger Load Factor %	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Over-all Revenue Load Factor %
DOMESTIC TRUNKS								
American	622,380	468,476	58.3	2,324,281	940,752	9,941,395	58,169,874	53.3
Braniff	185,544	83,942	58.0	448,522	175,405	891,194	9,563,420	47.4
Capital	291,053	129,639	53.2	678,129	307,176	538,943	13,955,498	48.7
Continental	110,704	69,450	47.8	248,372	122,951	511,563	7,546,842	39.7
Delta	334,603	198,596	63.1	692,893	316,455	1,529,265	21,647,794	52.7
Eastern	682,046	379,252	53.6	1,557,296	570,784	2,415,396	41,068,569	43.0
National	150,879	94,554	60.9	376,678	66,477	1,034,522	10,628,120	46.6
Northeast	152,787	78,706	56.7	152,771	54,250	295,370	8,046,079	45.0
Northwest	67,391	49,223	53.4	288,878	80,421	640,597	5,724,887	49.6
Trans World	386,485	328,611	55.7	1,752,866	806,807	4,884,705	38,988,213	55.7
United	691,081	489,170	60.8	4,460,107	1,157,172	8,311,228	60,812,762	52.9
Western	37,433	22,944	61.3	70,787	34,272	144,758	2,451,202	50.3
INTERNATIONAL								
American	7,971	8,938	65.1	10,779	957	301,986	1,241,692	55.5
Braniff	7,571	11,318	46.5	55,958	...	157,314	1,411,800	42.7
Caribbean Atlantic	38,816	2,805	66.8	2,465	...	10,056	275,606	66.2
Delta	1,374	1,578	36.1	1,186	...	19,416	192,324	36.0
Eastern	47,195	71,932	57.3	171,960	...	381,046	7,298,481	58.6
Mackey	16,016	2,671	53.7	...	235	14,981	277,813	53.3
National[2]	...	...	...	...	...	...	...	...
Northwest	10,632	19,921	41.8	1,556,092	1,418	518,054	4,214,072	64.0
Pan American								
Alaska	3,939	3,878	36.0	40,008	2,739	155,345	604,699	40.0
Atlantic	114,586	153,322	47.4	2,985,451	...	5,233,183	24,199,550	45.7
Latin America	94,716	115,359	59.4	482,453	...	4,410,270	16,709,947	60.1
Pacific	40,208	158,667	68.5	3,849,068	16,054	2,947,656	23,172,658	59.8
Panagra	10,541	18,564	59.4	104,054	...	760,156	2,861,282	59.9
Resort[3]	...	...	...	...	...	...	...	...
Trans Caribbean	8,016	13,575	60.8	...	...	558,742	1,276,412	65.8
Trans World	18,613	52,207	45.8	1,244,505	...	1,781,884	8,858,124	49.8
United	11,255	28,035	61.6	349,608	7,619	175,857	3,412,039	62.5
Western	1,780	2,768	63.0	5,212	...	11,328	299,683	57.7
LOCAL SERVICE								
Allegheny	60,767	12,577	39.7	23,101	33,171	58,155	1,315,237	42.4
Bonanza	29,300	7,389	53.8	13,214	3,648	15,139	741,088	55.4
Central	15,613	3,102	35.3	12,423	6,176	19,026	335,329	33.4
Frontier	29,817	8,324	43.2	37,643	13,035	71,683	920,593	48.2
Lake Central	30,053	4,788	32.9	9,267	20,843	6,486	494,698	32.1
Mohawk	55,934	11,286	43.5	23,715	25,190	23,750	1,149,044	41.1
North Central	77,882	14,063	40.8	53,554	52,761	60,508	1,518,852	42.4
Ozark	45,143	8,093	40.0	23,789	25,659	31,344	853,268	44.0
Pacific	40,857	9,691	49.4	17,753	4,472	8,235	954,652	49.7
Piedmont	36,474	7,500	42.1	13,745	12,812	22,633	767,931	44.0
Southern	31,016	5,647	31.6	23,841	12,270	19,565	597,394	33.4
Trans-Texas	26,790	6,142	40.6	24,749	12,551	42,070	667,625	42.3
West Coast	31,782	8,008	43.5	18,169	5,051	19,982	802,952	43.9
HAWAIIAN								
Aloha	27,597	4,185	66.2	3,357	...	5,298	343,826	53.8
Hawaiian	35,902	5,492	59.7	5,249	...	191,210	637,390	58.4
CARGO LINES								
AAXICO[3]	...	...	...	...	...	...	...	...
Aerovias Sud Americana	...	...	...	...	...	269,650	269,650	62.4
Flying Tiger	1,859	9,008	69.4	84,021	45,176	7,592,036	8,622,061	77.2
Riddle[1]	...	...	...	...	...	...	...	...
Seaboard World	...	...	...	1,061,670	...	3,853,216	4,930,089	64.3
Slick	1,117	4,648	96.1	...	...	760,405	1,223,381	94.9
HELICOPTER LINES								
Chicago Helicopter	19,210	322	35.7	1,191	...	...	31,910	30.3
Los Angeles Airways	3,554	133	52.2	5,910	2,689	...	21,372	60.5
New York Airways	11,991	246	56.8	1,329	874	557	27,720	55.6
ALASKA LINES								
Alaska Airlines	7,312	5,348	41.8	72,761	1,810	311,033	943,882	52.1
Alaska Coastal	4,242	438	55.4	3,927	...	4,661	53,306	63.8
Cordova	1,635	396	45.5	4,641	...	24,082	68,811	47.7
Ellis	3,612	207	47.2	2,503	...	2,477	26,174	59.6
Kodiak	810	449	44.8	434	...	529	5,413	41.9
Northern Consolidated	2,032	615	30.7	64,795	...	61,419	193,308	56.2
Pacific Northern	8,137	7,538	39.4	205,974	11,614	391,910	1,427,794	57.9
Reeve Aleutian	1,396	1,197	37.7	57,275	...	58,675	246,489	54.8
Western Alaska[1]	...	...	...	...	...	...	...	...
Wien Alaska	2,599	647	34.8	46,530	...	100,015	212,464	49.2
Avalon Air Transport	3,540	229	45.7	642		404	22,778	47.9
Samoan[1]	...	...	...	...	...	...	...	...

[1] Not available. [2] National has suspended service to Havana, its only international route. [3] Operations suspended.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.



AVIOBRIDGE used to shield jet passengers at Schiphol during inclement weather telescopes to 100 ft. in length, can move laterally and vertically in winds of up to 60 mph. Built by Holland's Aviolanda Maatschappu Voor Vliegtuigbouw N.V., it can be positioned in 120-150 sec.

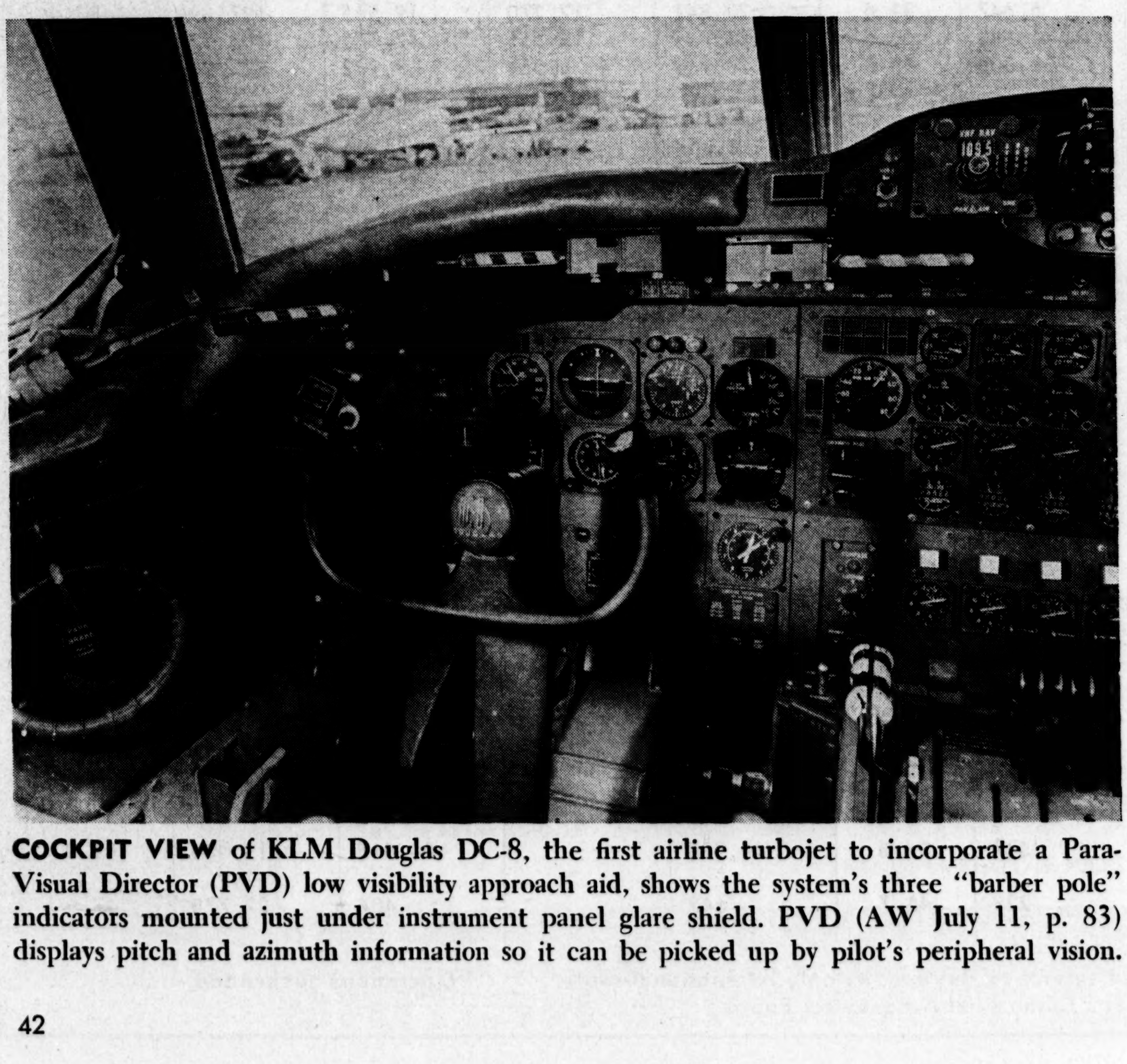
Devaluation Spurs KLM Modernization

By David H. Hoffman

Amsterdam—KLM Royal Dutch Airlines, with almost 20% of its shares in U. S. hands, is confident that heavy emphasis on modernization—coupled with Los Angeles landing rights—will ensure continued profits until the transition to supersonic transports gets under way.

To underscore its preoccupation with the future, the airline has begun a series of research projects here that range in scope from fully automatic landings to common contracts for all unions within the company. Substantial investment in these areas, KLM feels, will tend to hold down costs and thus lower next year's breakeven load factors.

At the same time, KLM admits that the Dutch government's decision to devalue the guilder will strongly influence earnings over the next few years. Precise impact of the 4.74% devaluation announced in March will be disclosed by forthcoming 1961 statistics. But some sources here already believe that the currency revision will force closer ties between KLM and U. S. banking and aviation industries.



COCKPIT VIEW of KLM Douglas DC-8, the first airline turbojet to incorporate a Para-Visual Director (PVD) low visibility approach aid, shows the system's three "barber pole" indicators mounted just under instrument panel glare shield. PVD (AW July 11, p. 83) displays pitch and azimuth information so it can be picked up by pilot's peripheral vision.

This is because international tariffs are based on the U. S. dollar and the United Kingdom's pound sterling. Now worth 3.6 instead of 3.8 Dutch guilders, a dollar earned by KLM brings in about 5% less real revenue than it did before devaluation.

In an effort to offset this loss, the airline can be expected to increase the proportion of its operating expenses that are satisfied with foreign currency. The bulk of this increase probably will benefit U. S. suppliers, which now are linked indirectly and directly to KLM by:

- **Credit line of $70 million** extended to the carrier by three U. S. banks—First National City Bank of New York, Chase Manhattan Bank and the Bank of America National Trust and Savings Assn. The bank-airline agreement stipulates that loans may be used only to purchase new equipment.
- **Firm KLM commitment** to utilize only Douglas DC-8s, assuming they remain available, as long-range jet transports pending availability of supersonic equipment. According to the Air Transport Assn., the purchase and maintenance of one DC-8 over a 10-yr. period produces $32 million of revenue for U. S. industries.
- **U. S. stockholders' interest** in the airline. About 69% of outstanding KLM common shares are held by the Dutch government. But by owning 20%, U. S. citizens form the second-ranking bloc, and the airline reports that if Americans holding KLM debentures exercised their conversion privilege,

the U.S. share of ownership would jump to 33%.

Despite a substantial drop in Lockheed Electra load factors and mounting competition from government-subsidized carriers in Europe, KLM showed net earnings of $2.7 million last year. But because operating expenses increased 14% while revenues rose only 12%, net earnings were $1.2 million less than in 1959 and dividends were pared to 5%. KLM distributed a 7% dividend in 1959, the highest in an unbroken string dating back to 1953.

According to KLM officials, who chose not to elaborate, European passenger reaction to the series of U.S. Electra accidents in 1959 and 1960 was far more "disappointing" than comparable reaction in the U.S. As the only major Electra operator in Europe last year, KLM scheduled the turboprops along medium-range routes also served by Sud Caravelles and 800 Series Vickers Viscounts.

One outcome of this competition was last year's KLM decision to withdraw $1.8 million from its reserves to cover "extra expenses and loss of revenue" attributable to Electra problems. Another may be KLM's plan to transfer its Electras to relatively short-range intra-European routes as soon as medium-range jets can be acquired.

KLM has not yet decided on the jet it should buy. It has, however, decided to make a purchase this year and observers here expect the announcement momentarily as manufacturers' representatives meet repeatedly with the airline's top management. Aircraft under consideration include the Sud Mk. 10 Caravelle, de Havilland Trident, Convair 880 and 990 and Boeing 727, with delivery the key to the carrier's final choice.

While awaiting the arrival of new aircraft, KLM has undertaken projects aimed at boosting the efficiency of its present jet fleet—which now accounts for about 50% of total airline revenue—and at cutting in-house costs. For example:

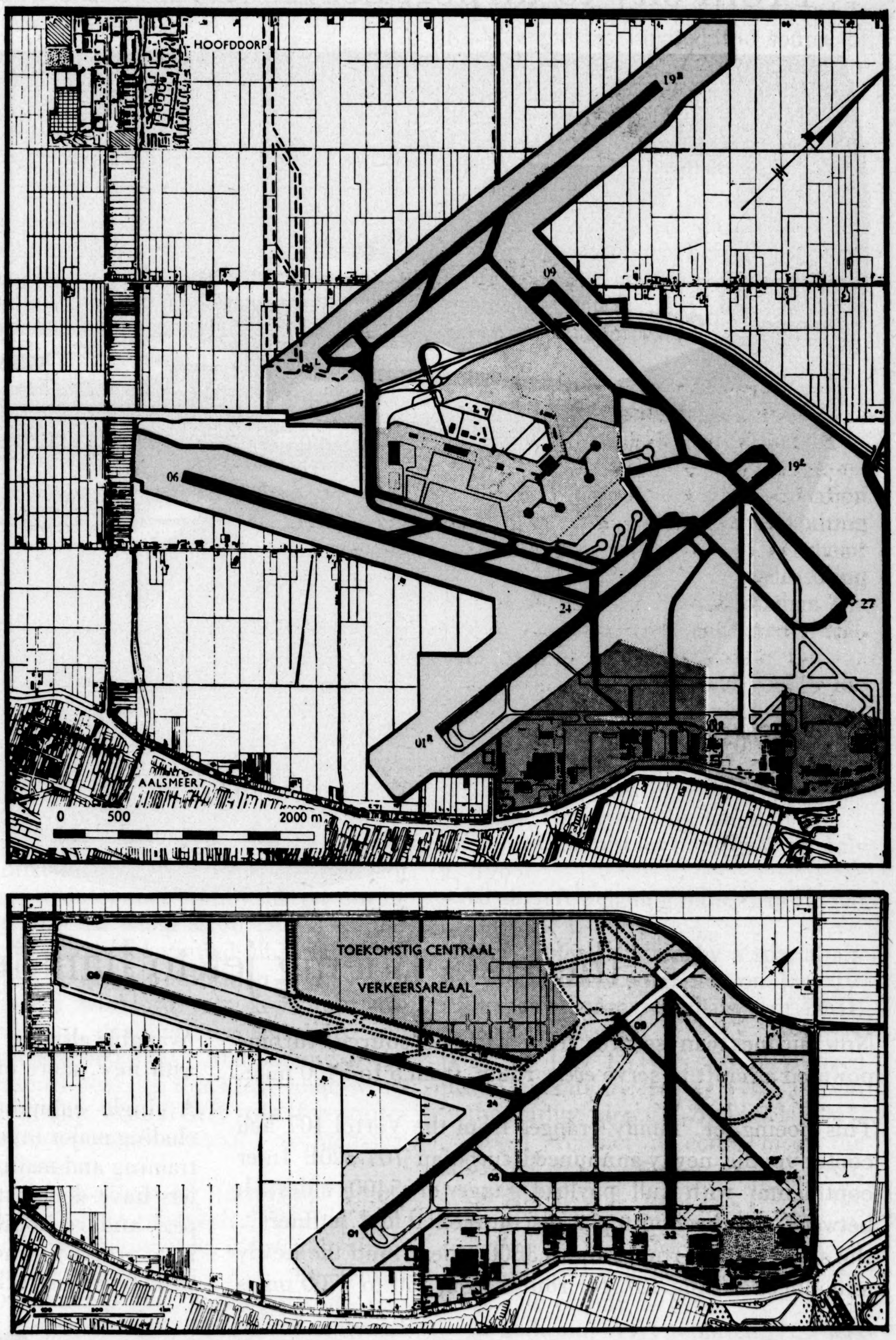
- **Fully automatic landings.** KLM assumes that for air traffic control purposes, automatic landing capability—including automatic flare-out—will be required of the supersonic transport when it is introduced. To anticipate this, the carrier has established a "supersonic steering group" and an advanced instrumentation or flight guidance department.

By testing various devices on DC-8s, these two groups hope to achieve automatic landing capability "within six to eight years," or well before the earliest estimates of supersonic transport availability.. But their intermediate goal is to lower current DC-8 minimums of 330-ft. ceiling and ¾-mi. visibility in steps—first to 200 ft. and ½ mi. as soon as possible (AW Apr.24, p. 40) and then to 100 ft. and ¼ mi. by 1965 or 1966.

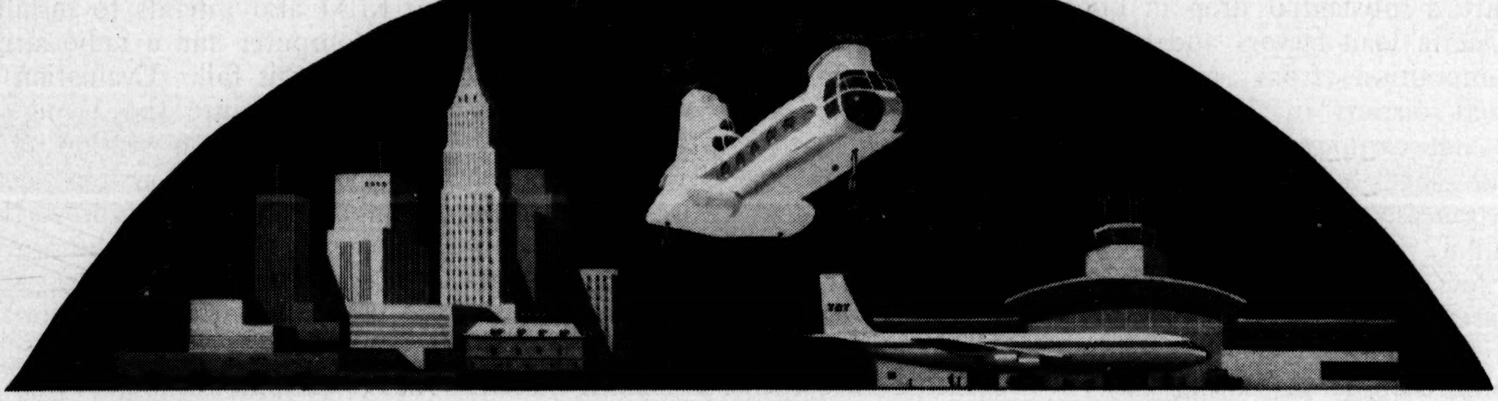
As an initial step, KLM has installed a Para Visual Director low visibility approach system in a DC-8 for evaluation this year, the first such installation in an operational airline jet. Manufactured by Smiths Aircraft Instruments, Ltd. of Great Britain, the PVD feeds altitude and azimuth information to a pilot executing a low visibility approach even while he is looking outside the cockpit. It thus eases the problem of transitioning from instrument to visual flight on let downs through a low, ragged ceiling.

KLM also intends to install a flare-out computer and a radio altimeter in a DC-8 this fall. Evaluation of these aids will require the laying of cable "leaders" along a section of the instrument landing system localizer at Schiphol Airport to improve ILS accuracy just prior to touchdown. While this project is under way, KLM will push ahead with a "re-education" program aimed at bolstering pilot confidence in approach aids already installed in the carrier's jet fleet.

- **Expansion of Schiphol Airport.** Op-



AMSTERDAM'S SCHIPHOL AIRPORT, under a $55-million expansion program, will have four 10,830-ft. runways in 1965. Radiating outward from a central terminal, the runways will cut present taxi times by over 50%. The Dutch believe the expansion will be adequate to cope with traffic only through 1975, when 4 million passengers are expected. In 1960, Schiphol enplaned and deplaned 1.5 million passengers, ranking eighth in Europe.



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erated by a limited liability company in which the cities of Amsterdam and Rotterdam, KLM and the Dutch government own almost all the stock, Schiphol last year ranked third among European terminals in freight and eighth in passenger traffic.

The airport company, N. V. Luchthaven Schiphol, reports a total of 90,000 aircraft movements and 1.5 million passenger movements last year. It forecasts that these figures will jump to 140,000 and 4 million respectively in 1975.

To accommodate this volume of traffic, the airport and its principal user, KLM, have charted a $56-million expansion program scheduled to get under way in 1965. Among other projects, it will entail the extension of three runways to 11,000 ft. and the construction of a new passenger terminal with fingers that incorporate 100-150 yd. moving sidewalks for enplaning and deplaning passengers.

The terminal, when finished, will stand at the center of a rough rectangle formed by two pairs of parallel runways. The fourth already has been lengthened to 11,000 ft. With the runways radiating from the terminal complex somewhat like spokes, taxi distances for arrivals and departures are kept to a minimum because aircraft land toward the terminal and take off away from it.

The flat Dutch countryside—Schiphol lies 13 ft. below sea level on the bed of a lake drained in 1850—offers few obstructions to even the most critical instrument approaches. Nevertheless, the airport plans to install surface detection radar next year to clear aircraft taxiing through fog and is considering ILS installations on all four of the new runways to complement the two Precision Approach Radar (GCA) now in operation.

- **Integrated flight crews.** KLM believes that the speed and highly automated systems of the supersonic transport may lead to a new concept in crew training and cockpit organization. A. W. Witholt, vice president and manager of KLM's flight division, told Aviation Week here that on the basis of preliminary studies he favored crewmen with dual or triple qualifications who could move freely from the pilot's seat to the engineer's panel to the navigator's table of the supersonic jet.

How such crewmen should be trained is now under study. Working with 700 relatively young pilots—airline pilots must retire at age 55 in The Netherlands—and 400 engineers, KLM is considering the possibility of farming out supersonic transport training to the Dutch civil aviation school, which now supplies a majority of the new pilots coming into the airline.

For the first time last year, KLM elected to follow the lead of some U. S. airlines in capitalizing training expenses. These totaled about $3.8 million for over-all upgrading.

KLM Freight Rise

KLM Royal Dutch Airlines reports that it moved ahead of Pan American World Airways in transatlantic freight volume during the 1961 first quarter to become the second-ranking cargo carrier on North Atlantic routes. Only Seaboard World Airlines, which carries significant quantities of freight under military contracts, had more cargo business than KLM. Ranking sixth among International Air Transport Assn. airlines in 1960 transatlantic passenger movements, KLM claims that it accounted for about 20% of all North Atlantic freight business last year.

Excluding mail and cargo shipped through Montreal, Houston or Caribbean airports, KLM hauled 7,227,972 lb. of eastbound cargo and 7,402,210 lb. of westbound cargo in 1960.

In its maintenance division, KLM has adapted some familiar overhaul techniques to achieve a DC-8 utilization of 13 hr. during the summer months when traffic is at its peak on the carrier's North Atlantic routes. For example, KLM sends its DC-8s through major overhaul only in winter, allowing 1.5 to 2 weeks of hangar time per aircraft.

Mixed Maintenance Concept

Other work is accomplished during 300-hr. equalized service checks. Thus KLM blends the continuous maintenance concept popular in the U. S. with a "one-time" overhaul system to minimize conflicts with the maintenance man's traditional enemy—the traffic and sales department.

Because overhaul is consigned to the winter months, manpower available for fleet maintenance climbs sharply during the summer when KLM DC-8s fly at a pace that, if continued all year, would equal an annual utilization of 4,600 hr. In-shop workloads are kept relatively constant, enabling regular shifts and precise scheduling. And because of the seasonal peaks in the KLM route structure, time is still left over for winter vacations and special maintenance training.

The problem of increasing engine time between overhauls (TBO) in Holland underscores the unusual relationship between KLM and the Dutch government, more particularly its federal aviation agency, Rijks Luchtvaart Dienst.

It is often said here that "KLM is civil aviation in Holland," a country so small that the carrier's jets traverse it in less than 20 min. It is also true that KLM represents the government's prime source of technical airline knowledge.

The outcome of this relationship is that the carrier can be said to control the escalation of its own TBOs. KLM does this by preparing its own engine overhaul programs, which almost invariably are approved by the Dutch aviation agency. To cite a recent illustration of the freedom enjoyed by KLM in this area, the TBO of one engine was increased by 200 hr. at a time when its failure rate was unusually high.

Despite this added increment, the number of failures attributable to the powerplant remained constant while KLM engineers isolated the source of trouble. Under the U. S. formula approach, now the subject of Federal Aviation Agency rulemaking (AW Apr. 17, p. 51), the engine's TBO probably would have been rolled back. But KLM reasoned that because none of the failures occurred during the last few hundred hours before overhaul, TBO could be advanced without compromising safety and did so with government approval.

FAA Proposes Early DME Installation

Washington – Federal Aviation Agency has proposed a rule requiring U. S. airlines to equip their turbojet transports with distance measuring equipment six months earlier than the installation timetable declared "realistic" by Air Transport Assn.

Under the proposed addition to the Civil Air Regulations published last week in the Federal Register, FAA would require DME on:

- **Airline turbojets** by July 1, 1962.
- **Airline turboprops** by Jan. 1, 1963.
- **Pressurized piston transports** by July 1, 1963.
- **All aircraft** weighing more than 12,500 lb. by Jan. 1, 1964.

ATA policy, drafted by a special airline operations conference on Jan. 19, calls for voluntary installation of DME on turbojets by Jan. 1, 1963, on turboprops by July 1, 1963, on pressurized piston aircraft by Jan. 1, 1964 and on "other airline aircraft" by Jan. 1, 1965.

Asked whether it could meet the advanced deadlines proposed by FAA, ATA said that it could not tell on the basis of available information. The association did say, however, that at least 244 turbojets will have DME by the FAA date of July 1, 1962.

In addition, ATA reported, 165 jets now on order will be delivered DME-equipped. Those to be received prior to July 1, 1962, are not included in the 244 prediction.

Comment on FAA's proposed rule is due by Aug. 1.

AIRLINE OBSERVER

▶ British Overseas Airways Corp. is expected to announce plans to operate its own passenger terminal at New York International Airport, under current negotiations now under way with the Port of New York Authority. The new terminal would be operational by 1964, when BOAC feels present facilities at international arrivals building will no longer be adequate. Passengers handled by the airline at Idlewild have increased 147% during the past four years.

▶ **International Civil Aviation Organization has recommended to 34 nations that airline transport pilots flying international routes retire at age 60, "because of the increasing possibility of sudden incapacity in a pilot with advancing age." The proposal was "sharply contested" said ICAO, but was passed by a small majority of votes cast.**

▶ Federal Aviation Agency has proposed that all aircraft operating in positive control areas be equipped with a radar beacon transponder that can transmit coded identification signals to ground radar beacon receivers. If adopted, the proposal would apply to only one positive control area at this time—the airspace from 24,000 to 35,000 ft. covered by long-range radar from Chicago, Indianapolis and New London, Ohio.

▶ **Czechoslovak State Airlines will inaugurate weekly flights between Prague and Beirut next month on its Far Eastern route. The Czechoslovakian government, meanwhile, predicts that CSA "will fly to all parts of the world except Australia, by the end of 1965."**

▶ British Air Transport Union, representing 25,000 airline employes, has purchased Trailblaze, Ltd., a long abandoned airline with neither aircraft nor assets, as a legal means of gaining recognition before the Air Transport Licensing Board. Currently negotiating with British United Airways, the union contends that purchase of the airline will entitle the union to register objections to airline applications. Present laws restrict appearances at Board hearings to airlines, owners of transport companies, holders of airport licenses and government departments (AW May 22, p. 34).

▶ **Air Line Stewards and Stewardesses Assn. recent affiliation with the Transport Workers Union may be significantly weakened as a result of an Air Line Pilots Assn. program to conduct representative elections on the airlines. By last week a majority of flight attendants on United Air Lines, Braniff Airways, Mohawk Airlines, Pacific Northern Airlines, West Coast Airlines and Alaska Air Lines had elected ALPA to represent them as a collective bargaining agent. Additional elections are in progress under the National Mediation Board at Continental Airlines, Capital Airlines, and North Central Airlines, with others pending at National Airlines, Ozark Air Lines, Piedmont Airlines and Frontier Airlines.**

▶ Aeroflot, the state-owned airline of Russia, has inaugurated its first commercial turbojet and turboprop service to Kuibyshev, on the Volga River, and to Mineralnye Vody, a resort city in the Caucasus. Both cities recently completed airport improvement projects.

▶ **Interested parties in New York's Dec. 16 midair collision do not anticipate a resumption of public hearings on the tragedy's cause before July. A major reason for the delay—phase one of the hearing ended last January—is to give Civil Aeronautics Board time to evaluate information from 40 flight recorders furnished by airlines operating jets into the New York area.**

▶ Civil Aeronautics Board is urging U.S. airlines to conduct monthly analyses of the readouts from flight recorders carried by their turbojet transports. CAB feels that the flight recorder tapes may indicate the need for maintenance action after aircraft have been subjected to temporary g forces.

▶ **North Atlantic load factors dropped an average of 7% during the first quarter of this year as compared with the same period of 1960. International Air Transport Assn. figures show the decrease resulted from a gain of 28.8% in passengers carried against a 46.9% increase in available seating capacity.**

SHORTLINES

▶ **Air France** has begun nonstop service, three times weekly, from Paris to Moscow with Caravelle turbojets. Flying time for the route is 3 hr. 55 min.

▶ **Braniff Airways** will utilize a $1-million jet simulator in operation at Love Field, Dallas, by next August. The simulator, built by Link, is a combination of a Boeing 707 cockpit and an electronic computer which will be used to train jet crews and give proficiency checks.

▶ **British European Airways** and Russia's Aeroflot are adding 35 extra flights with Comet 4B and Tupolev Tu-104 equipment between London and Moscow during the May 19-June 4 British Trade Fair in Moscow. BEA is adding 18 extra flights and Aeroflot 17 to the six flights weekly now being flown by the two airlines.

▶ **Frontier Airlines'** lenders have a Civil Aeronautics Board guarantee for loans totaling $900,000. The guarantee will allow Frontier to purchase two Convair 340s to replace DC-3s.

▶ **Japan Air Lines** reports a gross profit of $50 million for the fiscal year ended Mar. 31, 1961, an increase of 31% over the preceding fiscal year. Net profit for the same period was $1 million, a 59% increase over the preceding year.

▶ **Lake Central Airlines** has declared a dividend of 32.5 cents per share on its 6½%, $20 par value preferred stock for the period Mar. 1 through May 31.

▶ **Lufthansa German Airlines** carried 8,344 eastbound and 9,462 westbound passengers and 2.7 million lb. of cargo during the first quarter 1961, a gain of 89% and 115% respectively over the same period last year.

▶ **Northwest Airlines** declared a quarterly dividend of 20 cents per share for common stock and 32.8 cents per share for 5¼% preferred stock.

▶ **Pan American World Airways** reports over 300 tons of cargo carried eastbound over the North Atlantic during the week of Apr. 15 aboard 14 DC-7F all-cargo and 51 scheduled passenger flights.

▶ **Southern Airways** is making arrangements to serve Clarksville, Paris, Union City and Dyersburg, Tenn. for the first time on June 1. Flights will be twice daily for each city and originate in Memphis and terminate in Knoxville, Tenn.

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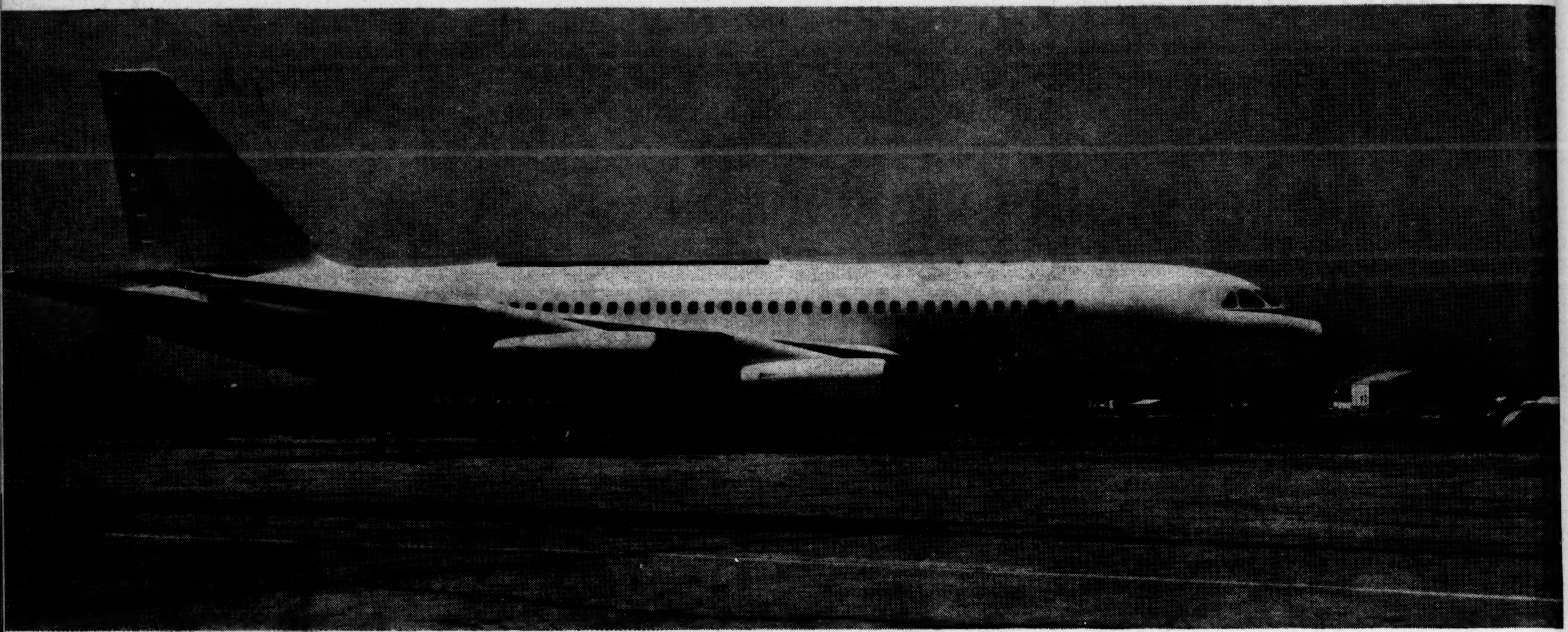


FIRST PRODUCTION 880-M, originally scheduled for delivery to Capital Airlines. High lift devices are all retracted in above view.

Aviation Week Pilot Report:

Takeoff Distance Cut on Convair 880-M

By William S. Reed

San Diego, Calif.—Addition of high lift devices, a modified control system and slightly increased thrust enables the Convair 880-M (for modified) to operate at increased gross weights while requiring shorter takeoff distances.

Effect of the high lift devices is to reduce stalling speed by about 10% with corresponding reductions in rotation and takeoff safety speeds. The result is that the 880-M can operate from high-altitude airports such as Albuquerque, N. M., without reducing payload on hot days.

Firsthand impressions of the 880-M's handling and performance, both to limiting Mach number and indicated airspeed, as well as low speed maneuverability and stalls, were gained by this Aviation Week pilot during a recent flight with Convair experimental test pilot William H. Harse. Formerly project pilot on structural and performance programs in the F-102 and F-106, Harse now is 880-M project pilot.

The Federal Aviation Agency issued a provisional airworthiness certificate for the Convair 880-M May 19. Thus, customer airlines—Civil Air Transport of Formosa, Japan Air Lines, Viasa of Venezuela and Alaska Airlines—were permitted to commence crew training and route familiarization with the aircraft in advance of complete certification scheduled for July.

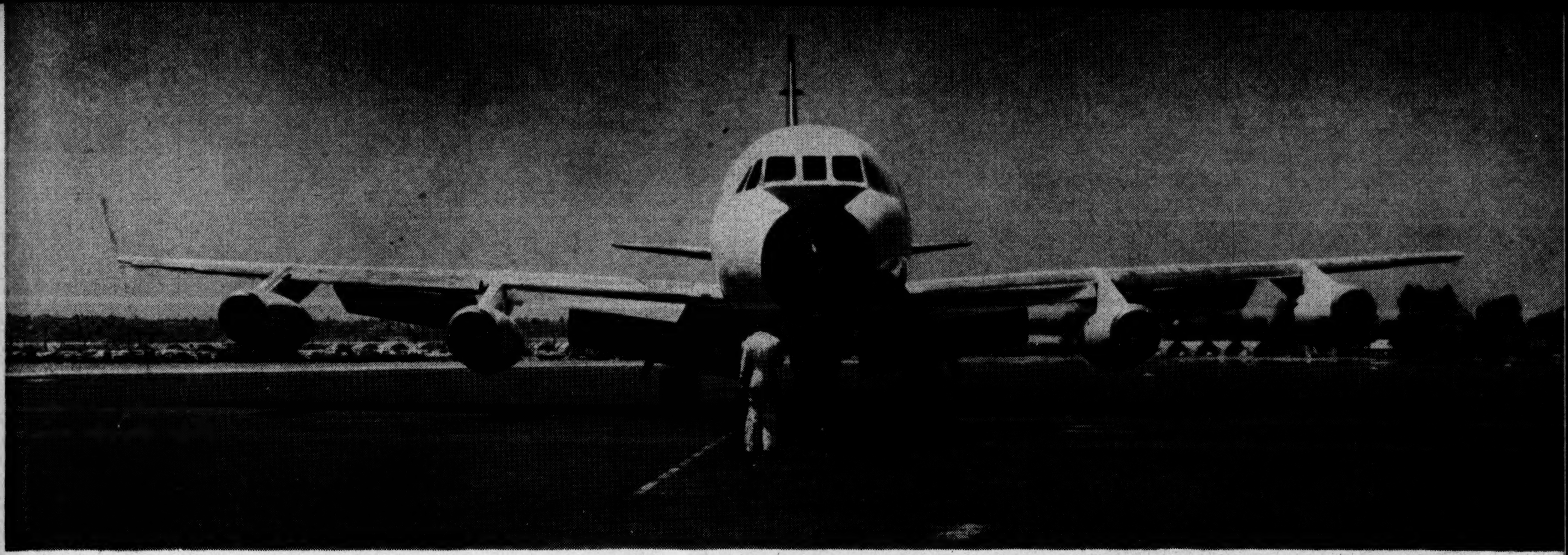
The aircraft used for this flight was N8487H, the first production Model 880-M. Preliminary investigation of the wing modifications were made in the original 880 prototype and it was in this latter aircraft that Harse did most of the experimental flying. N8487H, operating under an experimental type certificate, was in the interior configuration ordered by Capital Airlines but passenger seats were removed, a photo panel installed in the aft cabin and a series of trays anchored to the floor for carrying lead ballast were still in place

880-M Modifications

Modifications to the 880-M include:

- **Wing high lift devices.** Kreuger-type flaps between the fuselage and the inboard engine pylons increase the effective camber of the wing and form a seal between wing and pylon to forestall burble over the stabilizer. These are hydraulically extended with the main flaps. So are the slats added to the outboard of each engine pylon. As a result of these modifications, wing chord is increased by 2%. Inboard trailing edge flaps have greater area resulting from a 14 in. increase in span and an 18 in. increase in chord. Over-all result is an increase in maximum lift coefficient, $C_{L\ max.}$, from 1.62 to 1.95.
- **Boosted rudder which** comes into operation whenever flap travel passes the 3 deg. down mark. Hydraulic boost takes over when the flight tab-to-rudder differential is greater than 18 deg. and the linkage has been changed so that the tab streamlines at full throw to present a greater area, thereby increasing rudder effectiveness. An additional power boost system is fitted to the rudder pedals and is referred to by pilots as "power steering." This full time boost cuts rudder forces by one half, necessitating only 80 lb. push force for full rudder throw. Original scheme was to have the boost system actuated by a "q" sensor set to come into operation below 240 kt. IAS. This was troublesome however and has been abandoned in favor of tying it to the flap travel.
- **Lateral control response is increased** as a result of decreasing wheel throw for full aileron/spoiler operation from 110 deg. to 65 deg. At the same time, the spoilers, which produce 95% of the rolling moment, are brought into play with less wheel movement. As revealed later during landing, the lateral response of the 880-M is very good, especially in landing configuration, and little trouble was experienced in "finding neutral."
- **Thrust increase of 400 lb. per engine.** Inlet guide vane settings on the CJ805-3B engines have been rescheduled to permit greater mass flow—increasing thrust from 11,200 to 11,600 lb.
- **Wheel brakes designed for longer life.** Despite the increase in takeoff gross weight from 184,500 lb. to 191,500 lb., and the increase in landing gross from 132,800 to 155,000 lb., the lower stalling speed results in the 880-M having about the same kinetic energy at lift-off and touchdown as the 880. Increase in brake effectiveness is therefore not necessary but longer life is added to the braking system.

Gross weight of N8487H for the Aviation Week flight was 143,000 lb



HEAD-ON VIEW of the 880-M shows the enlarged trailing edge flap inboard, the Kreuger-type leading edge flap between fuselage and inboard engine pylons and the slats outboard of each pylon on the leading edge.

48,500 lb. under the maximum for which the aircraft will be certificated. Aboard were 40,000 lb. of fuel and five people; maximum fuel which can be carried by the 880-M is 75,432 lb.

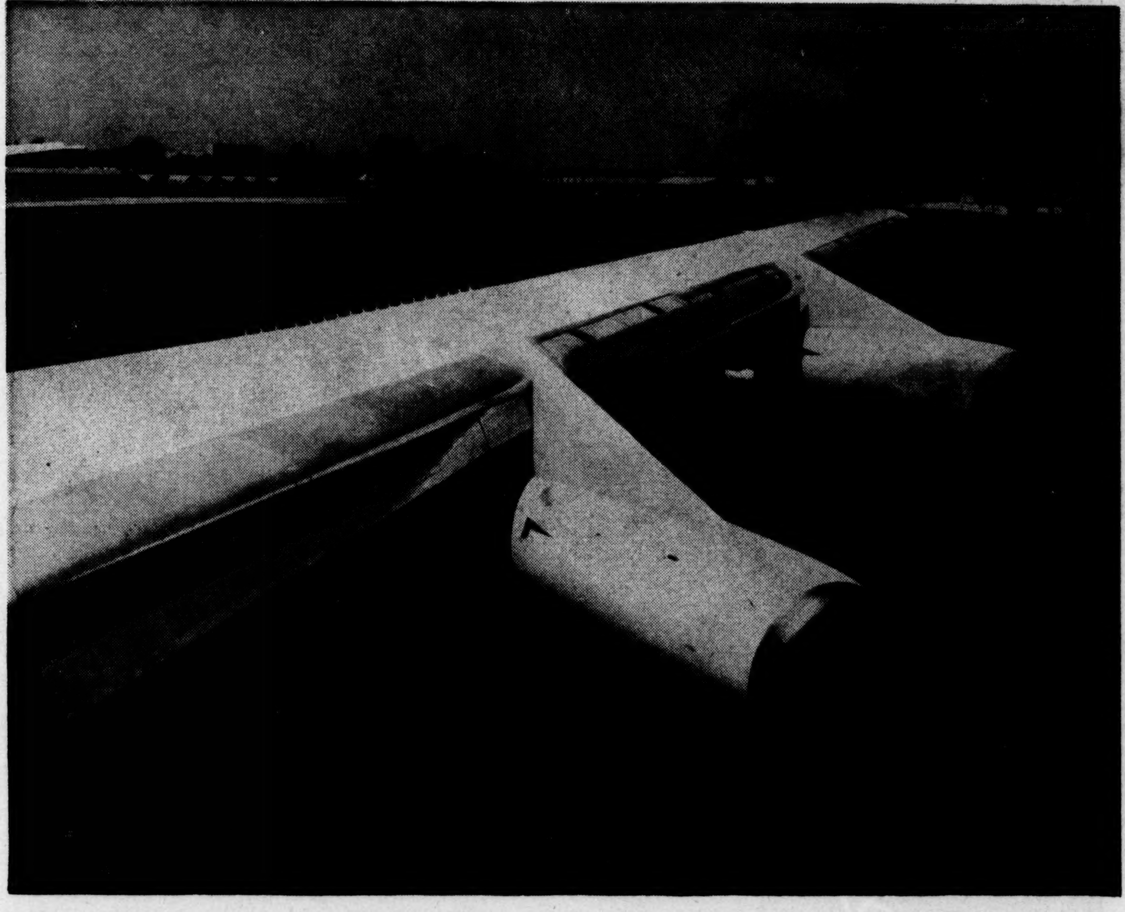
For the takeoff from Lindbergh Field, calculations showed that both V_1 (engine failure speed) and V_R (rotation speed) because of the light gross weight were 123 kt.; V_2 (takeoff safety speed) was established at 134 kt. Outside air temperature was 15C and for these ambient conditions, the exhaust pressure ratio (EPR) minimum was 2.61.

Ground Operation

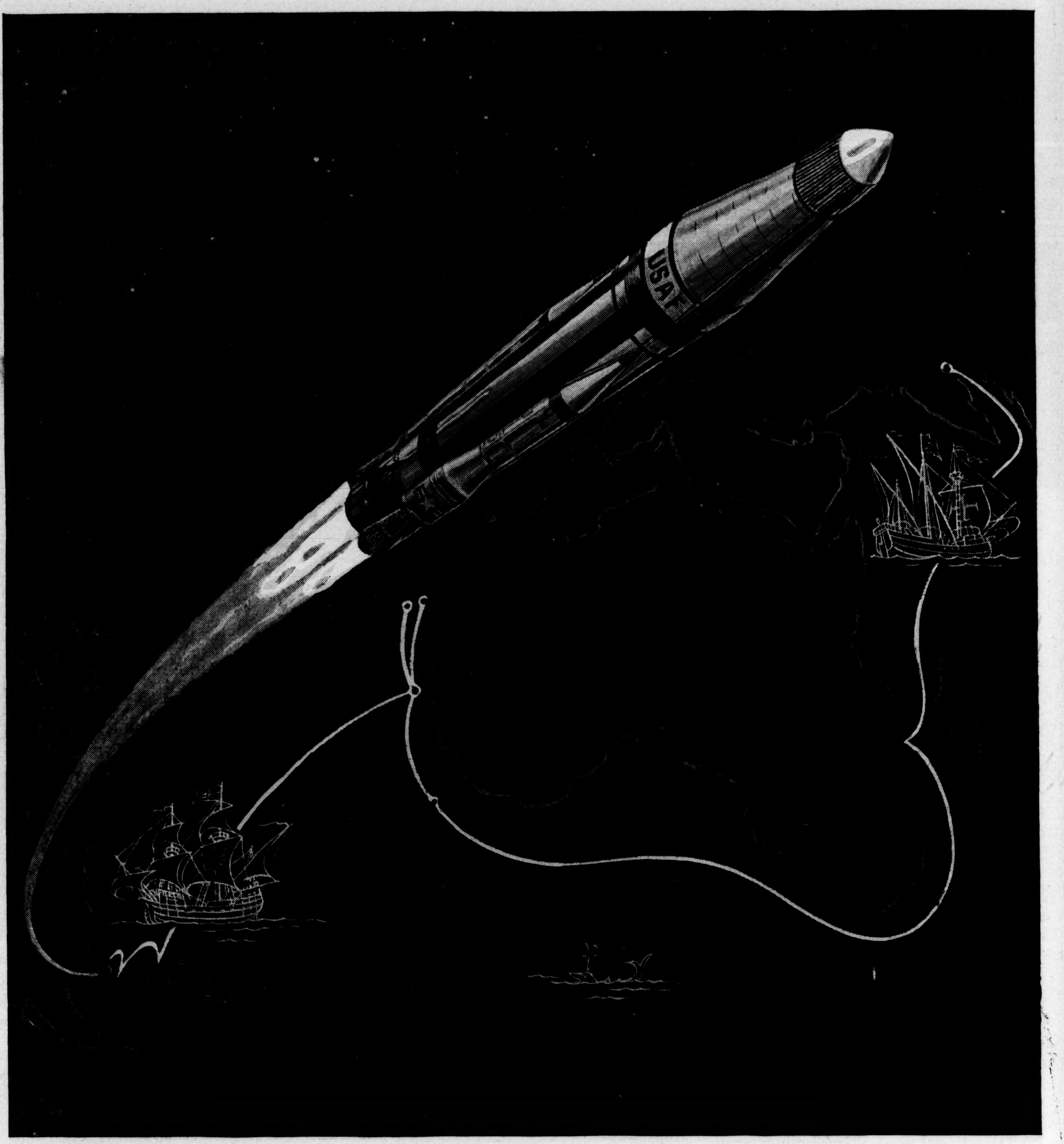
Ground operation of the 880-M offers nothing new over previous 880 models and is conducted with about the same ease as with contemporary transports such as the 707/720 and the DC-8 series aircraft. Engine response, a selling point with General Electric, is very rapid, more closely approaching that of reciprocating engines than most turbojets.

The aircraft is brought onto the runway and the power levers advanced to full open. After allowing 10 sec. for the readings to stabilize, EPR is checked for minimum and the other engine values crosschecked. Maximum rpm. is 103.5% and the steady state exhaust gas temperature (EGT) limit is about 630C.

Directional control normally is maintained by the use of nose wheel steering until reaching 80 kt. airspeed. Since the nose wheel will caster, directional control for all ground operation can be maintained by judicious use of power/wheel brake combinations, but this generally results in slightly longer takeoff runs. Lift-off is accomplished at V_R speed with a nominal 40-lb. pull force on the control yoke and the safety speed, V_2, is attained almost immedi-



TIGHT SEAL between the Kreuger flap and the inboard engine pylon are evident on the 880. Kreuger-type flaps between fuselage and inboard engine pylon and the slats outboard of the pylons are hydraulically operated and keyed to extend with the main trailing edge flaps. Reduction of 10% in stall speeds is brought about by these devices, first tested by General Dynamics on the 880.



Arma navigates new routes

Navigating with cross-staff and primitive compass, Prince Henry's Portuguese pilots took more than 80 years to find a route around Africa and reach India. The Spaniards took another 20 years to cross the Atlantic and reach the shores of Florida.

Today, missile-borne inertial guidance can navigate such distances in a matter of minutes and pin-point targets nearly half-way around the world. Other advantages of inertial navigation are immunity to outside interference, all-weather capability, salvo firing, and a minimum of ground equipment.

Arma, designer of America's first inertial guidance of intercontinental range accuracy, has these systems in full production with on-schedule deliveries. Although specified for the Atlas missile, the Arma system is equally adaptable to other aerospace programs and space exploration projects.

At Arma, research programs currently are exploring smaller, supersensitive devices for future generations of missile and space guidance systems. Arma, a division of American Bosch Arma Corporation, Garden City, New York. . . . The future is our business.

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ately. Acceleration to takeoff speed and lift-off is very rapid in the 880 and takeoff safety speed generally was exceeded.

Final climbout is conducted at 97% rpm. following flap retraction at 1,500 ft. above the runway after the airspeed has increased to about 180 kt. IAS. Once the aircraft had accelerated to en route climb speed of about 340 kt., we had broken out from a 5,000 ft. undercast and were headed for the Convair test area off the Pacific coast near Catalina Island. On passing 10,000 ft., rate of climb was 2,700 fpm. which agreed with the book value of 17 min. for a climb from sea level to 35,000 ft.

To demonstrate handling qualities, the 880-M was leveled off at 15,000 ft. and various maneuvers were executed to demonstrate stability and control. Dutch roll (yaw in one direction, roll in the opposite) was induced in the aircraft. Harse put in about 5 deg. of yaw to the right and 20 deg. of opposite bank and allowed the aircraft to recover hands off. There was no apparent tendency for the maneuver to become divergent and after about four cycles, the Dutch roll had damped to a barely perceptible amplitude. This maneuver was repeated at 35,000 ft. and, although damping was not quite so rapid, the aircraft recovered from the induced maneuver in a satisfactory time and manner. There was no yaw damper installed in the aircraft since it was awaiting autopilot installation of which the damper is part.

Stalls Performed

Power on and power off stalls in the clean and landing configuration were performed and all aspects of these maneuvers were satisfactory from the stability and control standpoint. The reason for installation of a stall warning indicator of the 880-M is apparent. Decreasing the stall speed by the addition of high lift devices has compromised the stall warning buffet margin of the aircraft in the landing configuration.

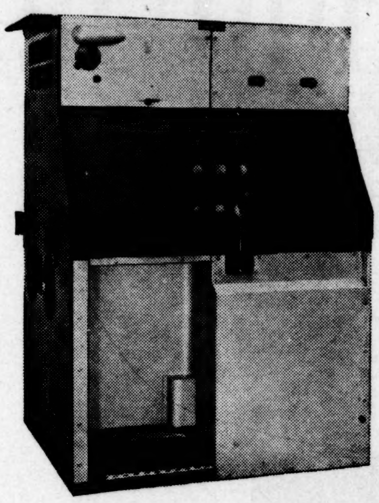
Only about 5 kt. warning is given between the onset of buffet and the stall at 98 kt. IAS. Artificial stall warning, although not yet installed in N8487H, will be included in all 880-Ms. A similar loss in stall buffet margin has been experienced in other jet transports incorporating high lift devices.

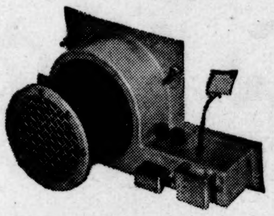
Engine-out conditions were simulated at 10,000 ft. with the severe case of two engines out on the same side being tested with no difficulty. Even with maximum continuous power on two engines, the asymmetric thrust can be handled with rudder and without any bank angle. Rudder boost comes in very handy at this point and forces—80 lb. for full throw—are not too high to be held by a pilot for the length of time required for a go-around or other critical maneuver. Force gradient on the rudder is positive, i. e., increased deflection requires higher force.

Following a simulated two-engine-out wave-off, the aircraft was flown to 35,000 ft. Climb schedule used was to hold 340 kt. until Mach .80 is intercepted (around 25,000 ft.), then a constant Mach number of .80 is followed to altitude. Certificated altitude limit is 41,000 ft.

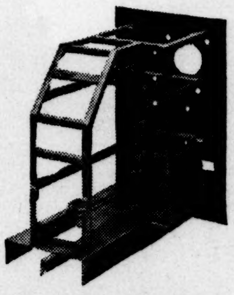
Power was left at maximum continuous, 97% rpm., and the aircraft allowed to accelerate to maximum normal operating speed, V_{NO}, of Mach .89. The level flight acceleration permitted a demonstration of the speed stability system installed in all 880 aircraft, which automatically trims the aircraft as speed changes, especially near the limiting Mach number. Therefore, as speed increases, the speed stability system, through inputs supplied by the "q" sensor, trims the aircraft nose up so that the pilot must trim nose down to maintain level flight. The reverse is true if the aircraft decelerates.

Similarly, should the aircraft nose up or down from a trim condition at cruise, the speed stability system will trim to bring it back to level flight. A neutrally stable aircraft would continue in the direction in which displaced, despite increase or decrease in airspeed. A negatively stable aircraft would diverge and pitch farther from the initial displacement attitude. Harse points out that the 880 has positive speed stability


Radar Console


Equipment Air Cooler

Radar Reflector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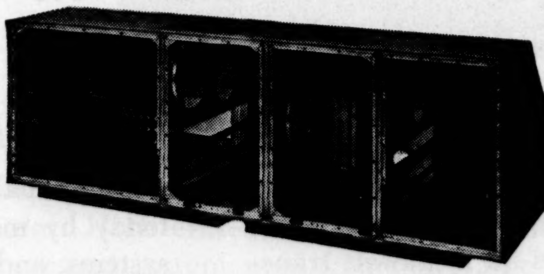
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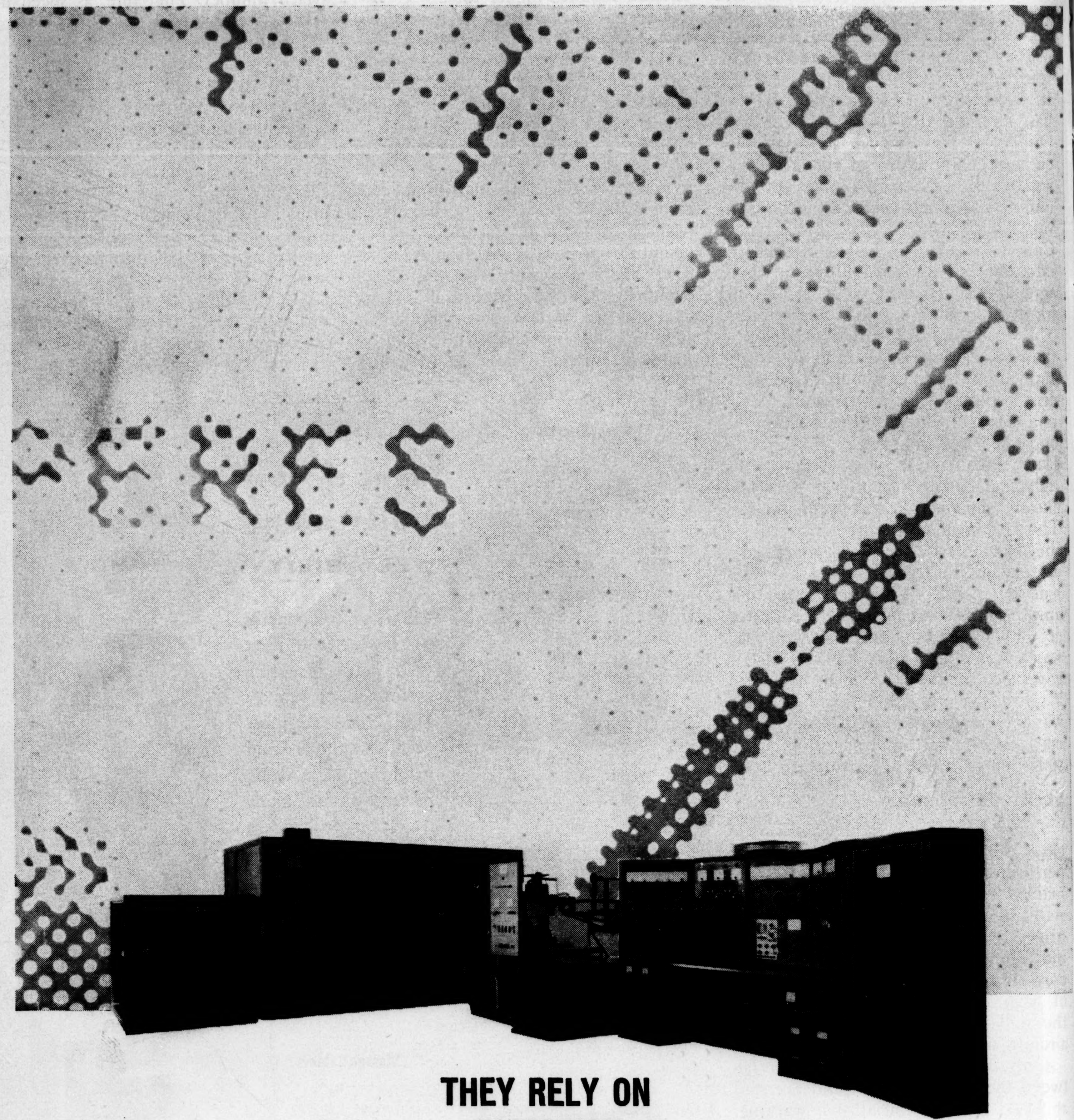

THEY RELY ON RADIATION FOR MEGAWATTS AT MEGACYCLES

Radiation at Stanford (formerly Levinthal) designs and builds high-power radar and communications transmitters, modulators and power supplies. This 30 megawatt transmitter for radar and component testing is typical. It demonstrates a unique capability for solving the special problems of superpower RF.

Two major design considerations in superpower RF equipment are performance *and* safety. In this unit—as in other Radiation-built systems with peak power to 100 megawatts and frequencies to 40,000 megacycles—special circuitry operates at miscrosecond speeds to prevent damage to the equipment. It includes five sub-assemblies with remote console containing all controls, interlock indicators and monitoring oscilloscope.

This capability of Radiation at Stanford is being utilized today by many prime contractors for advanced defense systems, and by makers of high-power commercial equipment. If you work with megawatts at megacycles, you can rely on it, too, for comprehensive solutions to your problems. Write Radiation at Stanford, Dept. AW-5, 3180 Hanover Street, Palo Alto, California, for detailed information.

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but not to the extent deemed desirable. It becomes critical near the limiting Mach number where "tuck" occurs, as it does in almost all swept-wing jets.

Although positive speed stability is required of all aircraft, its value in present day large jet aircraft with wide speed ranges is debatable among pilots. Speed stability was more important in the days of deep-muscle-sense flying than it is today when attitude flying is the order.

Jammed stabilizer technique was exercised on the descent while IAS was fairly high to show the effect of spoiler deflection on pitch angle. Deploying only the inboard spoilers causes the aircraft to pitch down; activation of the outboards causes a pitch up. To avoid confusion in times of emergency, a switch on the center pedestal aft of the speed brake handle controls which set of spoilers are activated. Center position is for simultaneous operation, foward position is for nose down and aft position is for nose up. It is unnecessary for the pilot to make any mental calculations as to which set of spoilers produce pitch in what direction since the switch selects the proper set.

Emergency descent, although not demonstrated on this flight, can be accomplished in rapid order should the occasion demand due to explosive decompression or other difficulty. From maximum altitude of 41,000 ft., descent can be accomplished at the rate of 14,000 fpm. With all engines at idle, main gear and spoilers can be extended and clearing turns made to bring the aircraft to an oxygen-safe altitude in slightly over two minutes.

Maximum normal operating speed, V_{NO}, was reached at 23,000 ft. with the aircraft in level flight. Power was maintained at 97% and airspeed was still increasing as 393 kt. appeared, indicating that excess power for greater speed still was available. At V_{NO}, Mach number was .89, indicated airspeed was 393 kt. for a true airspeed of 530 kt. or 610 mph.

The 880 then was flown to Ontario Airport where landings are practiced by Convair pilots because approach conditions at Lindbergh Field are less than ideal. Although some difficulty was encountered by this pilot in adapting to the special force wheel installed on the aircraft to measure control forces, little difficulty was experienced in landing the 880. By this time, the flight engineer calculated the gross weight at 116,000 lb. and the book showed that reference speed, V_{REF}, was 124 kt.

Traffic pattern was entered at 140 kt. with flaps at 20 deg. with gear down. Handling qualities in this condition seemed good with lateral response sufficient to give the aircraft a solid feel. Full flaps were lowered on the final approach and the airspeed reduced to

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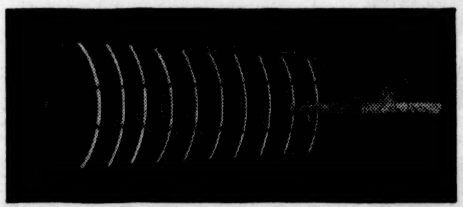

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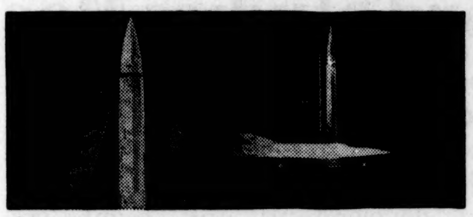

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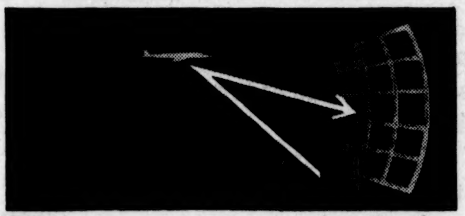

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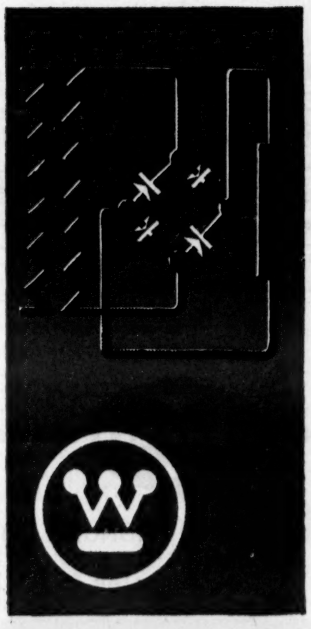

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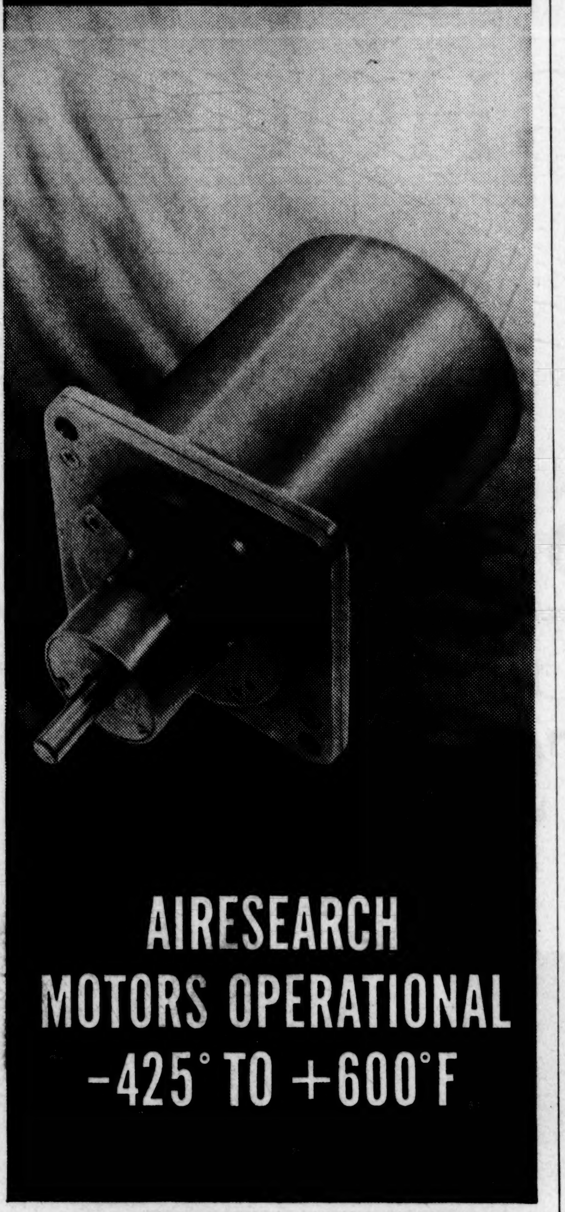

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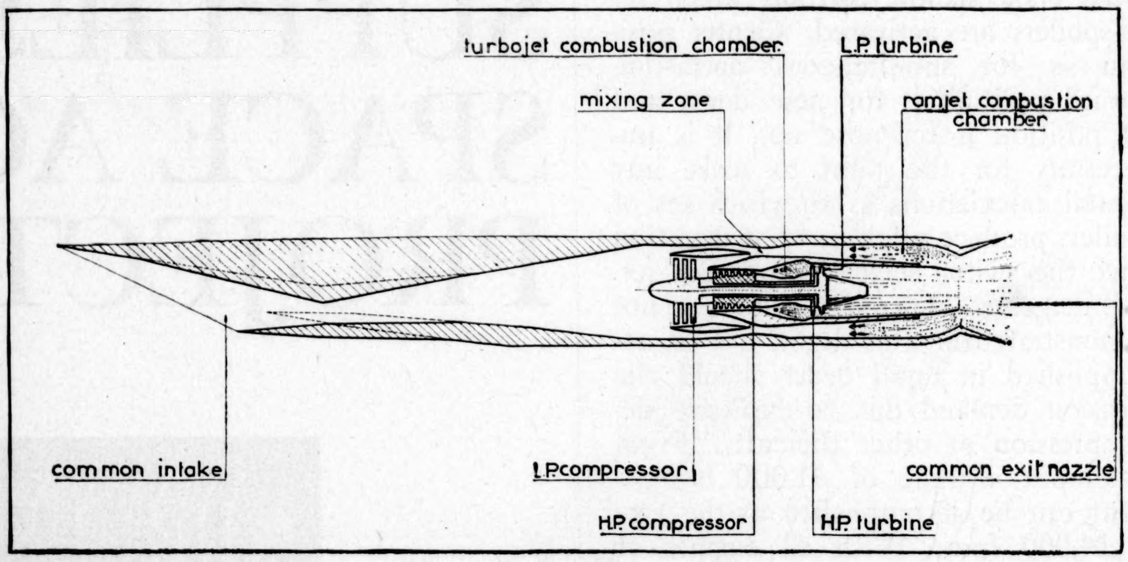
135 kt., slowing to 125 kt. at about the middle marker position. No deterioration in lateral control was noted as speed decreased nor was there a tendency to overcontrol. Rudder and elevator control, although less remarkable than the lateral control, nevertheless were entirely satisfactory.

Power was cut after the flareout was commenced, producing a main gear first landing. The nose is raised slightly if at all during the flareout. Deliberate action is necessary to bring the nose gear down to the runway so that braking and reverse thrust can be initiated.

Actuation of reverse thrust is indicated by lights on the panel which respond to the movement of four knobs located forward of, and connected to, the power levers. Once the lights indicate that the reversers have completed their cycle, reverser knobs are pulled aft. Actuation is very rapid and reverse thrust is very effective. Outboard engines will provide up to 5,600 lb. of reverse thrust while the inboards provide 5,200 lb. However, use of reverse thrust below 70 kt. will result in too much hot air ingestion in the outboards causing engine stalls.

Takeoff from Ontario was made at a gross weight of 115,000 lb. and engine-out performance was checked by cutting an outboard at V_1. Although not too good an illustration of performance at maximum gross, the excess of power available at this low gross weight gave the impression that engine loss at V_1, even at full gross, would not be difficult to cope with.



SCHEMATIC shows Nord proposal for combined turbo-ramjet for the supersonic transport.

Nord Studies Mach 3 Turbo-Ramjet

Supersonic powerplant now being studied by Nord-Aviation, Paris, under contract to the U. S. Air Force, is a logical extension of the company's unique development and flight experience of its turbo-ramjet engine which powers the Nord Griffon research aircraft.

The powerplant uses the combination of turbofan engine and ramjet to meet the extreme range of conditions imposed on operations of an engine for supersonic transports. The turbofan is mounted as the core of the combined engine, and mixes its bypass air with air from a common inlet duct to feed the annular ramjet around the turbofan engine.

Primary cycled air from the turbofan discharges in the center of the combined exhaust system. Exhaust nozzle and the upstream inlet for the powerplant use variable geometry.

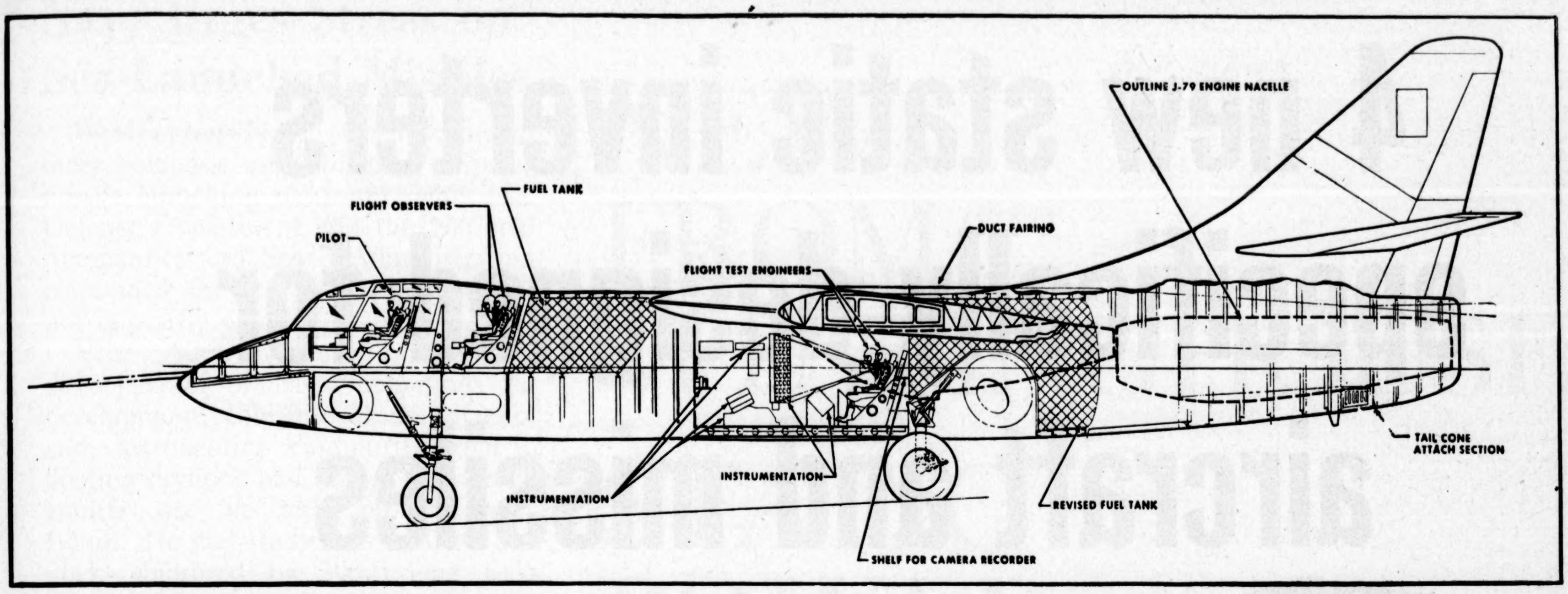
This layout in effect combines the characteristics of a duct-burning turbofan engine with those of a ramjet. By matching combined engine performance to the flight profile of a Mach 3 aircraft, Nord believes it has developed an optimum powerplant for the range of conditions including the critical subsonic portion of flight.

Static thrust for takeoff is augmented by lighting the ramjet; keeping the exit temperature down to 1,000K (1,342F) limits the noise level. Thrust of the combination is increased by 30% over the turbofan thrust, according to Nord figures. Specific weight at this condition remains about the same for the combined powerplant as it is for the turbofan alone. Specific fuel consumption is considerably higher.

Noise limitations keep operating temperature low during climb, although the ramjet can be lit to increase available thrust for the climb.

Full thrust is obtained from the ramjet powerplant during acceleration from subsonic to supersonic speed; it approximates three times that of the turbofan engine alone.

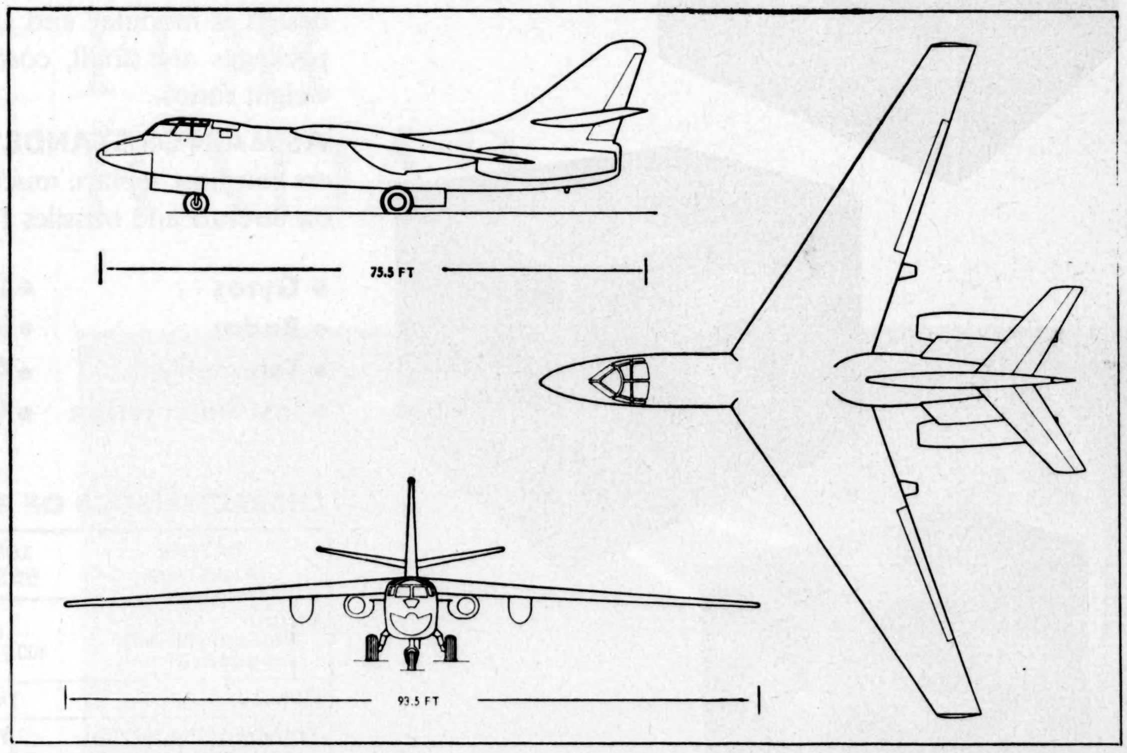
Supersonic cruise conditions call for maximum thrust from the turbofan plus additional thrust from the ramjet to meet total thrust requirement. The ramjet is sized for this critical design point; its specific fuel consumption in cruise will be about 1.5 lb./lb./hr.



RADICAL MODIFICATION of WB-66D test aircraft will include installation of fuselage-podded GE J79 engines under tail to replace wing-podded Allison J71 engines in the original plane. New engine installation will make room for pumps to power the LFC system.

WB-66Ds to Test Laminar Flow Control

By Russell Hawkes



NEW WING is being designed for the Douglas WB-66Ds. It will have a span of 93.5 ft. instead of the original 72.5 ft. and its area will be 1,250 sq. ft. instead of 780 sq. ft.

Los Angeles—Northrop Corp. is extensively redesigning two Douglas WB-66D weather reconnaissance airplanes to demonstrate the company's laminar flow control (LFC) system under a three-year, $30-million contract from USAF's Systems Command.

LFC is a suction-type boundary layer control system drawing air through paper-thin slots on all the surfaces and edges of the wing and is to be operated in the cruise portion of flight. It is powered by compressor bleed-air from propulsion engines and is expected to improve the range, endurance or payload of large aircraft by as much as 50% for a given fuel consumption by eliminating up to 80% of the friction drag on the wing. In turn, this will allow economical use of higher aspect ratio wings to cut drag due to lift and achieve minimum total drag.

The radical modification of the WB-66D test aircraft will include installation of fuselage-podded General Electric J79 engines under the tail to replace wing-podded Allison J71 engines in the original airplane. The new engine installation will make room for the wing-mounted suction pumps to power the LFC system. The pumping system is being designed by AiResearch Manufacturing Division of Garrett Corp. under a $1-million USAF Systems Command contract. The air turbines will be derived from existing AiResearch units.

To meet the requirements of the LFC installation, a new wing is being designed for the test airplanes. It will have a span of 93.5 ft. instead of the original 72.5 ft. and its area will be 1,250 sq. ft. rather than 780 sq. ft. The completely new wing is required by the necessity of maintaining structural strength while incorporating the ducts and skin slots of the LFC. Northrop gave the new wing an aspect ratio of 7.0 instead of the original 6.75 because the lower friction drag with LFC dictated a higher optimum value. The effect of higher aspect ratio is to cut drag due to lift.

Accommodations and instruments for two flight test engineers will be installed in the former bomb bay or equipment compartment. Fuselage fuel tankage also will be modified.

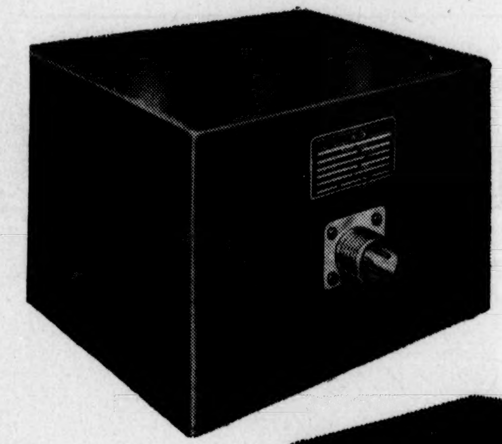
Each of the two test airplanes will have two identical LFC systems, one in each wing. Each LFC system is powered by a pair of engine bleed-air driven axial flow turbopumps. A two-stage turbopump draws the leading edge and upper wing surface boundary layer air through skin slots and a low pressure duct system and feeds it to a three-stage high pressure turbopump along with air from the lower wing surface and trailing edge skin slots. The air from the high pressure compressor and the turbine exhaust are then ejected to the rear to provide additional thrust. The two units can be controlled independently for a wide range of operating conditions.

Exhaust from each turbine and compressor will add 300-500 lb. thrust.

Northrop plans to operate the LFC during takeoff and landing, though the system is optimized for cruise conditions and will add little or nothing to the low-speed performance of the airplane. The main reason for this decision is to keep the slots from being clogged by dust.

HAMILTON STANDARD ANNOUNCES...

4 new static inverters specifically designed for aircraft and missiles



Hamilton Standard has developed a new line of 100-VA and 500-VA inverters that establishes an important increase in inverter reliability and performance. The units are specifically designed for airborne use. They possess extremely high overload and short circuit capacity and offer wide operating ambient temperature ranges. The basic design is modular and utilizes silicon transistors throughout. The packages are small, compact and deliver high over-all power-to-weight ratios.

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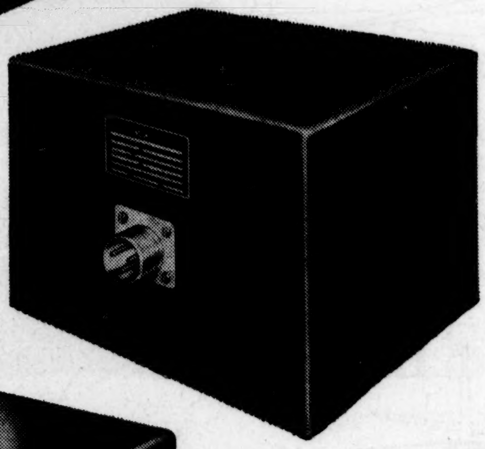

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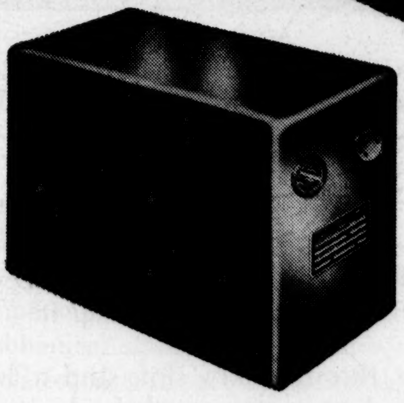
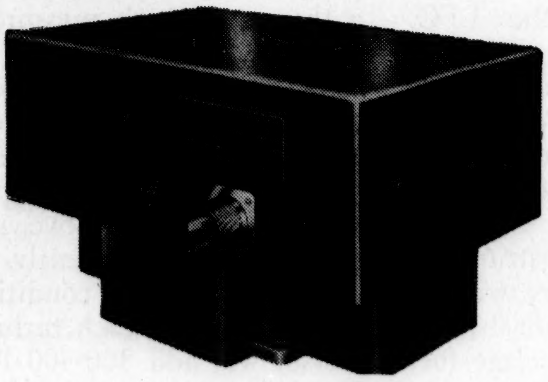


CHARACTERISTICS OF 100-VA and 500-VA STATIC INVERTERS

RATING **PART NO.**	**100 va** **555546**	**100 va** **566480**	**100 va** **566470**	**500 va** **570250**
Output **Voltage (Nom.)** **Frequency**	115 v 400±0.25%	115 or 200 v 400±1%	115 v 400±1%	115 or 200 v 400±0.25%
Phases	Three	Single or three	Single	Single or three
Transient Protection	Yes	Yes	Yes	Yes
Temp. Ranges	−55°C to 125°C	−55°C to 85°C	−55°C to 71°C	−55°C to 125°C
Input **Voltage (Range)**	18-29v dc	20-29v dc	20-29v dc	14-29v dc



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ELECTRONICS

Navy Urges Stress on Sea-Launched Missiles

Washington—Navy recently urged more emphasis on developing ships as missile launching platforms, while the Defense Department and the National Aeronautics and Space Administration contended the sea launch approach is not currently practical.

Vice Adm. John T. Hayward, deputy chief of naval operations for development, told the House Science and Astronautics Committee that a floating drydock had proved a practical launch site in tests off Eniwetok Island. He said studies showed the drydock, stabilized by 200-ft.-long jacks that press against the bottom of the sea, could be erected for launching at a cost of $7 million, compared with $21 million for constructing the same type equipment on the island.

Recommending more emphasis on sea platforms, Adm. Hayward said such mobile facilities would cause fewer political problems than land bases and would offer the advantages of safety, flexibility and economy.

John H. Rubel, deputy director of Defense research and engineering, conceded it would be an advantage to have both permanent and mobile launch sites located so space vehicles could be launched directly into equatorial orbit rather than "doglegged" from existing bases. But the cost of such equatorial sites "cannot economically be justified at this time," he said. Bases within the U. S. are adequate for current programs, he said, adding that both the

Information Inundation

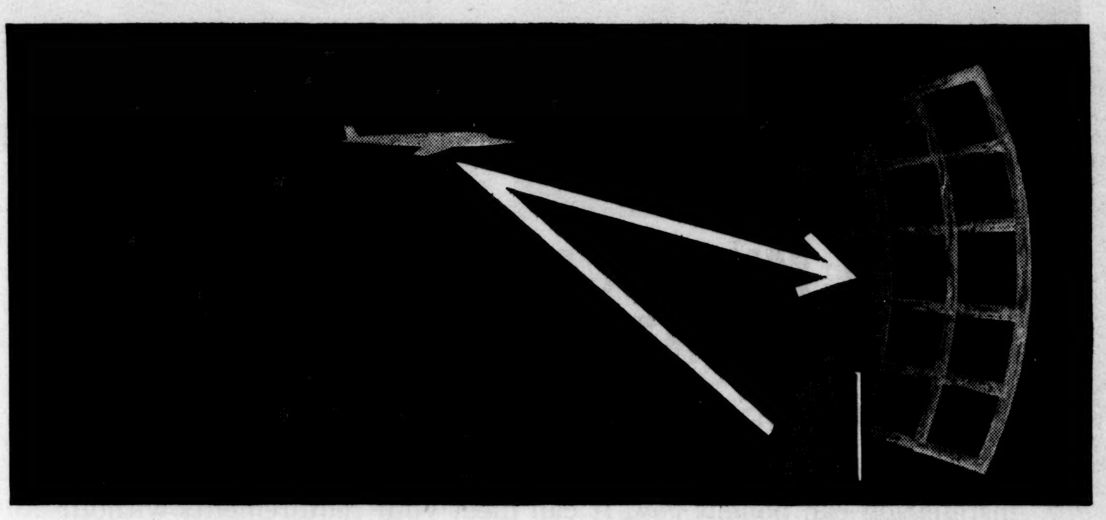
Finding and using information developed in scientific disciplines is perhaps the most crucial problem of optimum scientific progress.

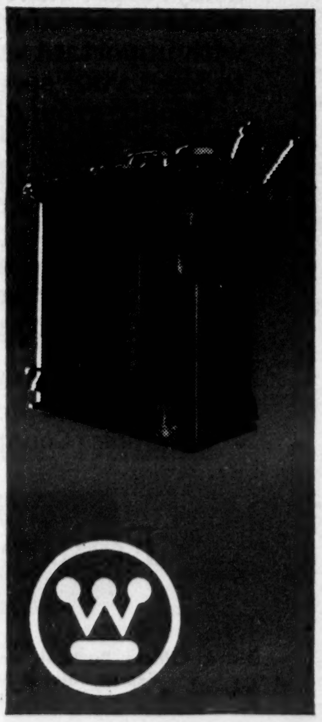
Brig. Gen. Benjamin G. Holzman, commanding USAF's Cambridge Research Laboratories, makes the point this way in Perspective, a quarterly report from Cornell Aeronautical Laboratory:

"Let's consider a hypothetical chemist named Dr. Jones. Dr. Jones is rather an unusual chemist; he can read 30 languages fluently. He has an equally unusual job; he has to attend no committee meetings, write no reports or letters, answer no telephone calls, perform no actual technical tasks, or even talk to anybody. All he has to do is to try to keep up with the literature of his own field. Dr. Jones can read four papers an hour and he works a forty-hour week. On 1 January 1959 he began reading all papers of chemical interest published in 1958. On 31 December 1959 he found himself ten years behind in his reading."

NEW FROM WESTINGHOUSE:

STATIC POWER SUPPLIES FOR RADAR





Large static radar power supplies for d-c output call for regulated high power, high voltage. Westinghouse delivers it. Positively precise. Typical equipment now furnished by Westinghouse includes switchgear, voltage regulator, rectifier, resistor and capacitor assemblies, and associated controls. Unlimited power ratings can be delivered. Units rated 1,000 kw are currently available. Before a spec is written, consult Westinghouse. Rectifier assembly opposite is part of power package supplied for BMEWS. For help in solving your static power supply problems, contact your local Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

J-92502

Westinghouse

ENGINEERING
REPORT
ON BENDIX COMPONENTS

HOW MUCH CAN BENDIX SAVE YOU IN ANTENNA PEDESTALS?

GET OUR SPECIFIC ENGINEERING PROPOSAL

Bendix experience in ground radar pedestal design, manufacture and installation can benefit *you*. It can meet your requirements without delay. Since basic design and tooling have already been accomplished, modifications, for your prototype needs, can be made quickly—and with important savings—or, we can design a completely new pedestal to meet your specific needs.

Bendix ground-installation radar pedestals are lightweight, compact, air transportable. They possess a high degree of accuracy, and have been completely proved in the field. Bendix also is widely experienced in airborne radar systems for weather and target tracking purposes.

If these demonstrated radar capabilities meet your needs, write today for further information, including a *specific engineering proposal*. What are your requirements?

EXAMPLES OF APPLICATIONS:
Weather Radar • Storm Detection • Meteorological Tracking • Mortar Tracking • Electronic Countermeasure • Satellite Tracking • Drone Surveillance • Telemetering

Eclipse-Pioneer Division
Teterboro, N. J.
THE Bendix CORPORATION

District Offices: Burbank, and San Francisco, Calif.; Seattle, Wash.; Dayton, Ohio; and Washington, D.C.
Export Sales & Service: Bendix International, 205 E. 42nd St., New York 17, N. Y.

Defense Department and NASA are keeping the equatorial site question under constant review.

Milton W. Rosen, deputy director of NASA's launch vehicle programs, said: "NASA has no requirements at the present time for the use of ships, drydocks or associated platforms to support vehicle programs now in force. Future programs will be concerned with nuclear equipped vehicles and with very large boosters. A study is about to be initiated within NASA to determine launch site requirements for vehicles in these categories."

Hydrazine Fuel Being Produced for Titan II

Saltville—Volume production of hydrazine, one of the two non-cryogenic storable fuels to be used in the Titan II missile, has begun at this Air Force plant in western Virginia. The new $15-million plant is operated by the Olin Mathieson Chemical Corp. under a three-year $25-million contract.

Anhydrous (lacking water) hydrazine is an inorganic fuel made from caustic soda, chlorine and ammonia. In miscible combination with an equal quantity of unsymmetrical dimethyl hydrazine (UDMH), manufactured by the Food Machinery Corp., the composite fuel burns hypergolically with the oxidizer, nitrogen tetroxide, made by the Allied Chemical Corp.

Specific impulse of the Titan II propellant is about 262 sec. compared with 280 sec. of Titan I, which uses liquid oxygen and RP-1. The storable propellants are denser, however, and allow for longer burning time of the Aerojet-General engines. Thrust of the Titan II is about 480,000 lb., compared with 380,000 lb. of Titan I (AW June 27, p. 34).

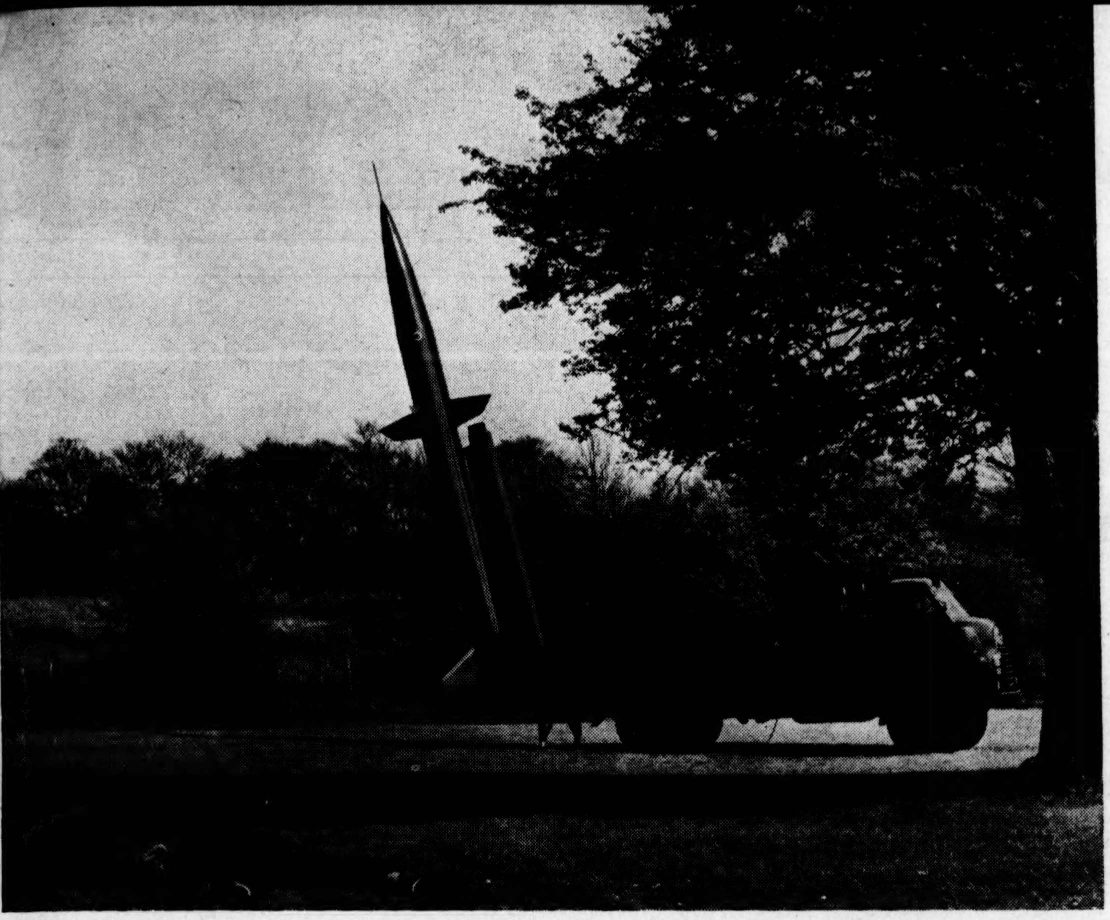
The highly-automated Saltville plant, requiring about 100 men, is on a 24-hr. production schedule and the fuel is being transported to Aerojet's Sacramento, Calif., test facility where Titan II engines are being static fired.

USAF to Train Space Pilots at Edwards AFB

Washington—USAF plans to expand its Experimental Flight Test Pilot School to include a special 24-week course for space pilots.

The school, located at the Air Force Flight Test Center, Edwards AFB, Calif., will have a course distinct from the one now given test pilots and only a selected few graduates would be chosen.

Instruction will include familiarization with subgravity, training with reaction controls and stability outside aerodynamic influences.



Blue Water Designed for Mobility

Blue Water solid fuel surface-to-surface missile, in what appears to be fullscale mockup above, has been designed for air transport and can be hauled aboard its own transporter-erector mounted on a 3-ton truck. Missile has raked tips on forward cruciform wing arrangement, probably for flight path control. English Electric, the manufacturer, claims missile is independent of ground control and is immune to enemy countermeasures. Note remote firing device between soldiers.

PRODUCTION BRIEFING

Saturn flight booster, designated SA-1, was captive fired for 111 sec. at Marshall Space Flight Center and developed 1,315,000 lb. thrust.

Navy Sikorsky HSS-2 helicopter has completed its carrier suitability trials, part of the Board of Inspection and Survey trials. It is scheduled for introduction to the fleet later this year.

Damage assessment center, which would permit nuclear warfare decisions to be made rapidly, will be built under Defense Atomic Support Agency contracts including $3 million to the Systems Development Corp.; $1.5 million to the Control Data Corp., and $1 million to Ramo-Wooldridge Division of Thompson Ramo Wooldridge Corp.

Martin Earth-Moon Study

Washington—Martin Co. has been awarded a $75,000 contract to study methods of manned earth-moon transportation, the manned space flight project now considered the Project Apollo follow-on.

National Aeronautics and Space Administration contract calls for a study of problems of lunar landing and immediate return for three men; 30-day stay on the moon for three, and a permanent moon base to house 10-12 men.

Navy Bureau of Ships has ordered design of integrated ship-board electronic systems in which many subsystems would be assembled and installed as a single structural unit (AW May 8, p. 23). Collins Radio's Alpha Corp. will work on a system for a guided missile frigate under a $1.4-million award, Electric Boat Division of General Dynamics has a $790,000 contract for a nuclear-powered attack submarine system, and a Hazeltine Corp. contract for $759,000 covers a similar effort for a guided missile escort vessel.

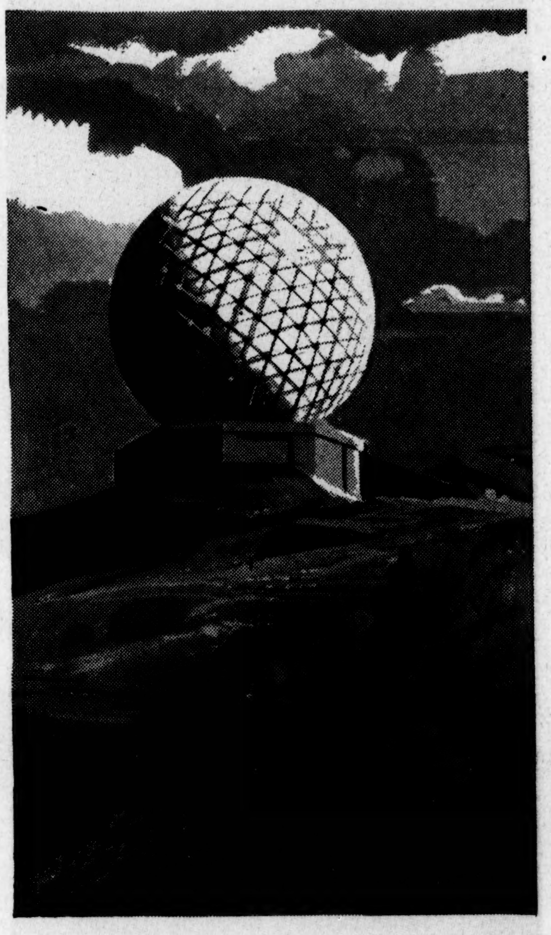
Justice Department has filed a suit for $22,000 against a Norwegian shipping company for damages to the Saturn barge Paleomon in a collision with a Norwegian freighter last month en route from Huntsville, Ala., to Port Canaveral, Fla.

Air Force Systems Command has awarded a $2-million contract to the Armour Research Foundation to develop methods of analyzing electronic interference from devices ranging from walkie-talkies to large radars. Work will be done through the newly established Electromagnetic Compatibility Analysis Facility at Annapolis, Md.

Navy has awarded a follow-on production contract for $33,400,000 to the Sperry Gyroscope Co., division of Sperry Rand Corp., for the SPG-55 Terrier automatic missile guidance radar systems.

ENGINEERING REPORT ON OTHER BENDIX COMPONENT PACKAGES

PRECISION DATA AND CONTROL SYSTEMS FOR LARGE RADAR ANTENNAS



Through intensive research and development for major programs, Bendix offers a wealth of design experience in both digital and analog radar control and data systems. We can:

1 Develop *complete systems or subsystems* to comply with any customer requirement.

2 Provide a wide range of installation options, i.e.: one antenna or a battery; control of one radar by another; digital or analog control. Systems with accuracies of .005° or better can be offered.

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PACKAGED COMPONENTS

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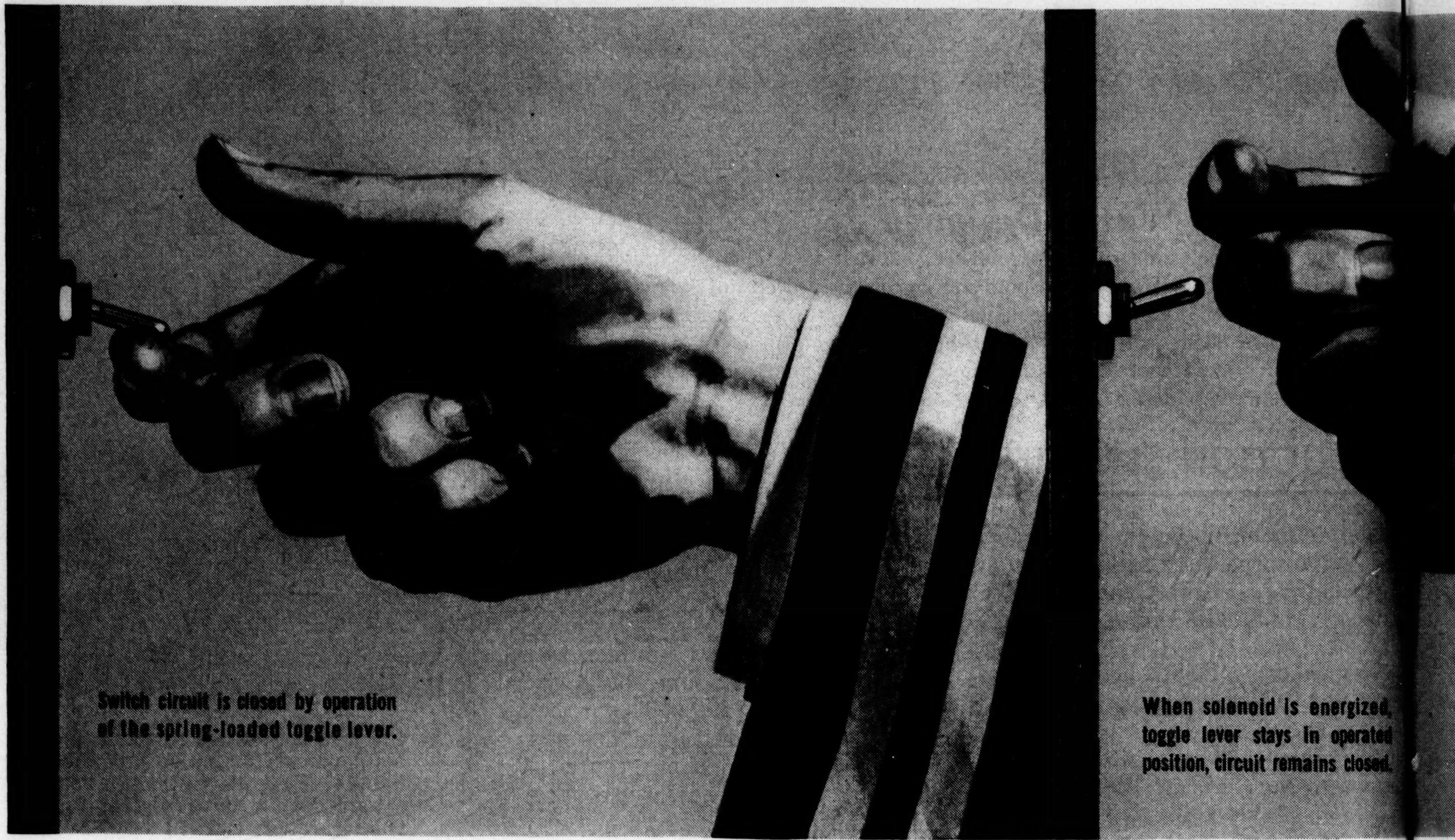
THE Bendix CORPORATION

Teterboro, N. J.

HONEYWELL

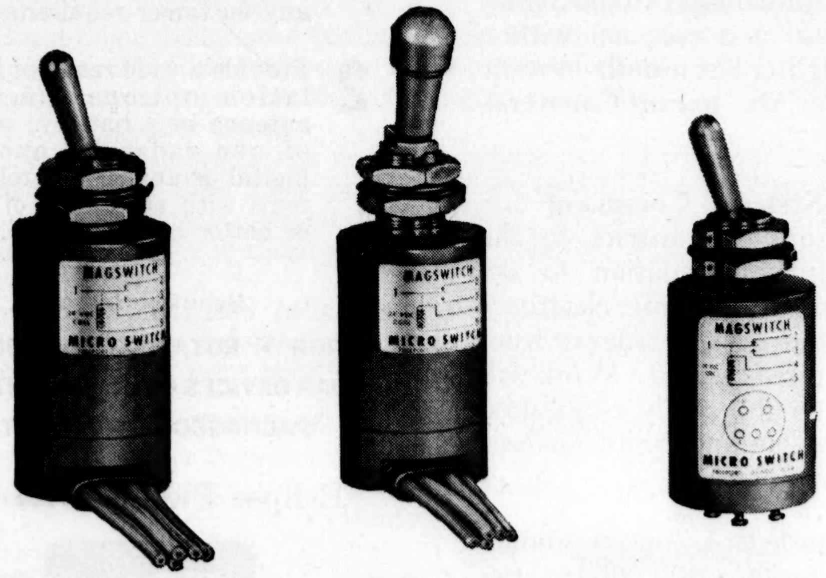
MICRO SWITCH Precision Switches

NEW MAGNETIC HOLD-IN SWITCH



Switch circuit is closed by operation of the spring-loaded toggle lever.

When solenoid is energized, toggle lever stays in operated position, circuit remains closed.


MAGSWITCH
MICRO SWITCH
MAGSWITCH
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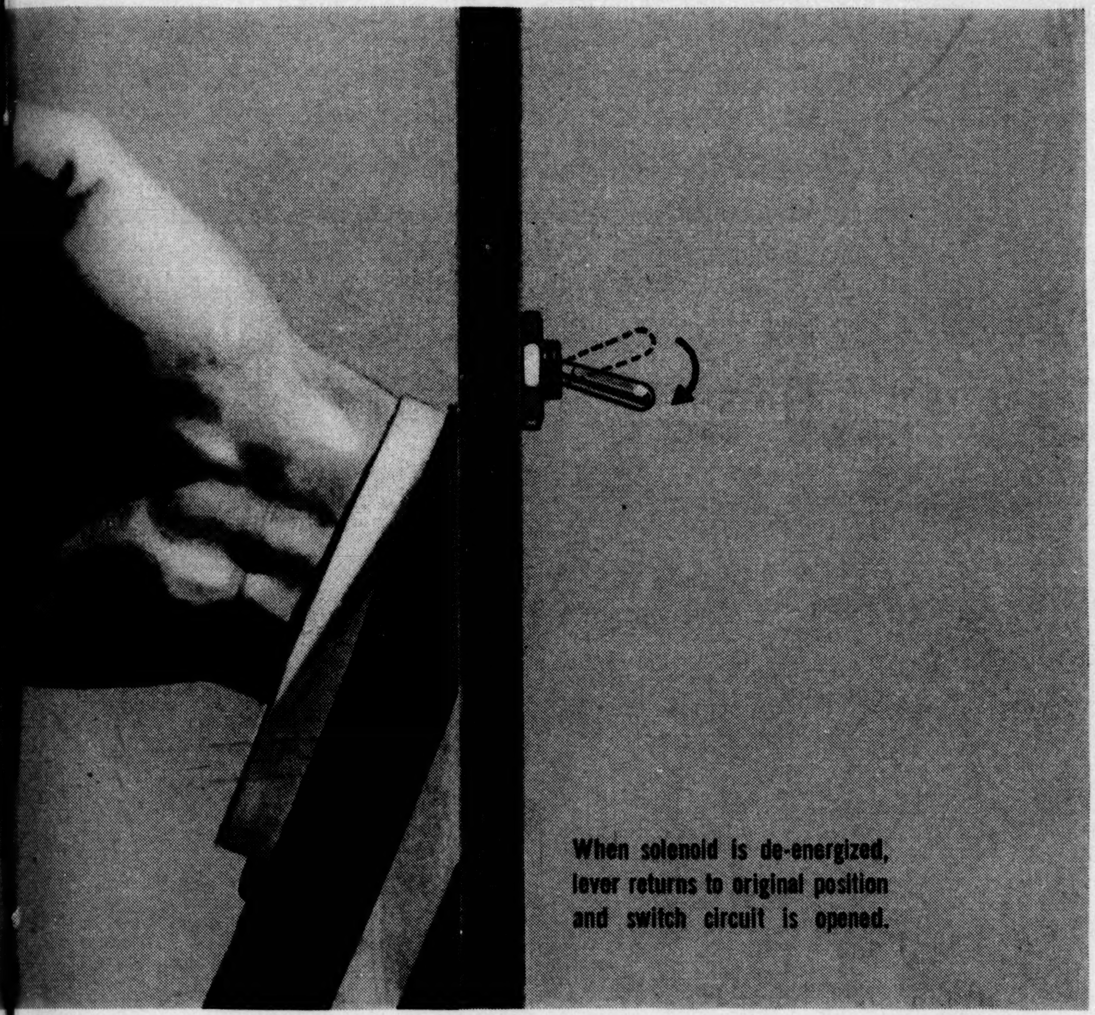
MICRO SWITCH

"5ET" SERIES SWITCHES

THE "ET" SERIES includes models with either double-pole double-throw or single-pole double-throw circuitry. Turret type solder terminals are available for easy, wrap-around connections. "ET" Switches are also available with sealed lead wires extending at a 90° angle from the base. Where safety requires, a pull-to-unlock lever is available which is locked out of momentary position.

PERMITS REMOTE ELECTRICAL RELEASE



When solenoid is de-energized, lever returns to original position and switch circuit is opened.

MAGSWITCH
MICRO SWITCH

"6ET"—ACTUAL SIZE

THE NEW "6ET" MAGSWITCH* is a sealed momentary-action toggle switch with a built-in solenoid. When the solenoid is energized, actuation of the toggle lever holds the switch in operating (maintained) condition. Breaking the solenoid circuit (usually done remotely) releases the solenoid-held lever, converting the switch from maintained to momentary condition. Release can also be accomplished by manually overriding the toggle lever.

The precision, double-pole double-throw switching unit and solenoid are contained in one compact unit. The "6ET" measures approximately 2¼" behind the panel and one inch in diameter. This switch requires no auxiliary relays as do other remotely controlled switches—another saving in space.

Switching unit and solenoid are sealed within an enclosure which has been evacuated and filled with inert gas under pressure, which insures reliable operation, regardless of changes in atmospheric conditions. An elastomer seal at the base of the toggle lever prevents entry of dust or moisture. The "6ET" meets immersion test requirements of MIL-E-5272, procedure 1. See the Yellow Pages for the nearby MICRO SWITCH Branch Office or write for Data Sheet No. 121.

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MICRO SWITCH Precision Switches

HOW WILL THIS REVOLUTION IN TECHNOLOGY AFFECT YOUR BUSINESS?

Already, the Hamilton-Zeiss high energy density electron beam welder is being used to weld refractory metals, foils and honeycomb sections . . . to solve special production problems of the space age. This revolutionary equipment fires the imagination of everyone who sees it demonstrated. Almost daily, new applications are developed that make possible new manufacturing techniques in electronics, in atomic energy, in the missile and aircraft industries, to name just a few. North American Aviation, Westinghouse, Pratt & Whitney Aircraft, Olin and Argonne National Laboratory are among those currently using the Hamilton-Zeiss electron beam welder.

The Hamilton-Zeiss equipment combines the advanced metallurgical and production knowledge of Hamilton-Standard with the unsurpassed skill of the Carl Zeiss company in precision optics.

How it works: Electron beams accelerated in a vacuum to 110,000 miles/sec. and focused precisely with an exclusive Zeiss magnetic lens system produce a heat source for welding which, in respect to energy density, mobility and precision, exceeds that of all other known methods. The electron beam may be pulsed to control duration and frequency of operation, thus minimizing thermal distortion and permitting welding of foils, for example.

Results: The Hamilton-Zeiss equipment produces the deepest, fastest, most reliable welds with least distortion of adjoining metal. With this unique process, it is possible for the first time to join materials whose melting points vary widely, such as metal to ceramic, metal to glass, and tungsten to carbon; to weld materials with different dimensions and geometries, such as ultra-fine wires and leads to large terminals, and foil to sheet.

Unique equipment: Hamilton-Standard, with over twenty years of metallurgical experience and meeting rigid government specifications, has exhaustively tested the welds produced with the Hamilton-Zeiss equipment. The data demonstrate conclusively that the Hamilton-Zeiss method produces welds, in miniature and large workpieces, that are as strong as the original materials themselves. Your engineers will tell you that such results are possible only by the use of high energy density, precision focusing by the Zeiss magnetic lens system and pulsing of the electron beam — all exclusive features of the Hamilton-Zeiss equipment.

Find out what this revolution in technology can mean to your company. For full information call Hamilton-Electrona, Inc., exclusive marketing agent for Hamilton-Zeiss equipment in the United States and Canada.

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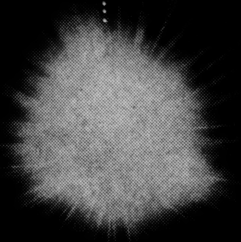


BUSINESS FLYING

Improved Business Plane Market Forecast

By Erwin J. Bulban

Dallas—Signs of a rising trend in business aircraft sales and production are becoming evident, indicating that the marked softness in the market last fall and early this year may be ending.

During that period, manufacturers reduced output to allow their sales outlets to work off excess field inventories.

Increases as yet appear to be minor, but at least the period of long inactivity that markedly braked sales appears to have shown a turn for the better, an AVIATION WEEK survey indicates.

The trend is as yet still in its early stages and has not yet made itself felt so strongly that there are across-the-board increases in output of all models, nor is the upturn firm all over the country. But manufacturers express considerable optimism that it will continue to improve (see table p. 75).

Cessna Aircraft Co. says a sharp upturn in retail sales in recent weeks, indicating that an economic rise is in progress, has prompted it to increase its production schedules for this month, June and July to provide for an additional 200 units over those scheduled earlier for these three months.

Beech Aircraft Corp. recently effected upward revision of its earlier production program. Queen Air output is being boosted about 60% over a line output that had been slowed considerably some six weeks ago—in effect, new Model 65 production is about 20% higher than at any previous level, according to a company spokesman. Light-twin Baron output has been stepped up 20% and Bonanza production is up 10%. Factory sources said distributor-dealer orders to the factory in April showed a 55% gain over March, 1961, with the increase largely in Queen Air, Baron, Bonanza and Debonair models. A "healthy backlog" is also attributed to the new version of the twin-engine Travel Air (AW May 8, p. 107).

Aero Commander, Inc., reports that it has accelerated its twin-engine Commander assembly line—with flow of parts to the line adjusted from a 15-hr. time span to a 13-hr. period—in effect providing an additional two or three airplanes per month over previous schedules.

Ordinarily, the production increases might not be so significant because sales to distributors and dealers are one thing—retail sales might not be keeping pace. But the fact that the manufacturers are keenly aware of the situation that many dealers were in just a few months ago—in some cases, lack of capital on the part of some caused them to drop their affiliations—would deter them from jeopardizing their sales organization further by loading them with unjustifiable production unless it could be sold.

The trend is somewhat spotty in regard to particular models, for various manufacturers—it also varies in sections of the country. W. T. Piper, for example, when asked to comment on the Cessna increase, said—"We're not happy with the way our heavier models are moving and the future doesn't look that good." He added, however, that there is a remarkable interest in the very light Piper Colt two-seat plane—on which earlier production plans have been revised sharply upward to bring original schedules for 420 units by the end of October to 1,100 units in that period. The four-place Cherokee replacement for the Tri-Pacer is also being brought up to five-a-day production.

Sales Outlet Response

Response by the sales outlets to AVIATION WEEK queries showed that their experience, like the factories, did not yet conform to any set pattern, except that there was a noticeable upturn in customer interest over previous months.

- **California**, generally a high-volume sales area, reported a marked increase in retail sales. Cessna sales representatives said that, although this is certainly no record year, there is a definite uptrend—sales that were off a little just before the end of the year have come back with more than the usual spring surge. Feeling was that some dealers may run out of airplanes to sell before the factory can catch up and supply them. In this area, they said, there was little or no evidence of a recession, although this market does not seem to feel these things as much as the East and Midwest. Buyers seem to be favoring purchases of the smaller aircraft.

Beech-SFERMA Talks

First visit by top Beech Aircraft Corp. management personnel to SFERMA, French engine manufacturers, with whom Beech has an agreement covering co-operative development of turboprop engines for its aircraft, may presage a major decision soon on the airframe builder's part regarding its plans in this field.

Executive Vice President Frank E. Hedrick and Marketing Vice President Wyman Henry have scheduled a significant portion of a European visit to study foreign technical developments for discussions with SFERMA. They are also key figures in a Beech executive committee which makes policy decisions on future technical programs. Beech engineers previously have maintained liaison with the French turbine engine maker.

Hedrick and Wyman also will visit company distributors in England and on the continent during their tour.

California Piper representatives indicated that there has been a big improvement in sales since Jan. 1—much bigger than the seasonal upswing. But in the last two weeks in April and to date in May, there has been a slight softening of the market—which, following the sour experience of last fall, has dealers worried. This company's sales outlet spokesman also saw a tendency for distribution to favor the lighter, less expensive airplane, such as the Colt.

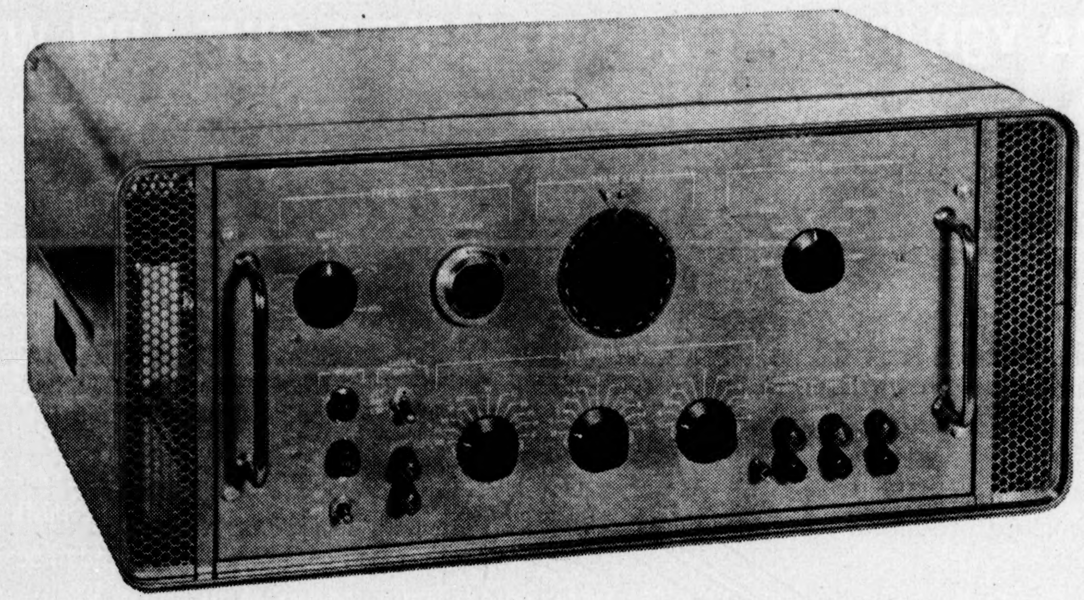
A Beech sales outlet spokesman reported that he had spotted no trends except the seasonal upturn, although he did not see any sign of the recession.

- **East Coast** reaction was mixed. Piper retail sales outlets were more cautious than West Coast. One felt that business was about the same as the same period last year, although the feeling seemed to be that although unit sales might be lower, dollar volumes would not be affected drastically, because of the cost of heavier models replacing previous models—the Cherokee replacing the Tri-Pacer, for example. "I don't feel that the increase is anything to get excited about," the spokesman in this area noted.

A Cessna outlet in the East indicated that there had been some business upturn, but that much of the optimism was being generated at factory levels, where the over-all picture was being grasped.

Beech Aircraft's representative in the New York area reported that sales were up about 20% over the same period last year, with the major increase being in the more expensive heavier aircraft, with sale of four Queen Airs and three Super G-18s on the books thus far this year. Decrease in sales of the lighter models is attributed to unusually bad weather this winter.

- **Dallas, Tex.**, probably shows the least signs of an uptrend. A Piper sales outlet confessed that the market had



WIDER

RANGE WITH GREATER ACCURACY!

This Vought Electronics Servo Analyzer is an *all-electronic* instrument covering the dynamic range of most servo systems *without* the troublesome maintenance requirements of mechanical multipliers.

Modulation rates of .005 to 1000 cps in five ranges are provided in sinusoidal, step, and ramp functions either directly or in suppressed carrier form. Modulation frequency accuracy readings of 2% are possible.

Other important unit specifications are:

- carrier frequency range of 50 to 10,000 cps
- carrier phase shift of less than 2° to 5 kc
- signal attenuation of 0 to 99 db in 0.1 db steps
- phase measurement accuracy of 2°

Use of Vought Electronics Servo Analyzer has been demonstrated successfully with *Titan* and *Minuteman* missiles as well as in industrial laboratory applications. It is available in both bench and rack mounted models.

For more complete information about this versatile instrument, contact:

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Chance Vought Electronics Division
P. O. Box 1500, Arlington, Texas

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dropped so drastically early this year that he felt that he could no longer continue his franchise and has turned to handling used aircraft exclusively. Business was good November through February, he stated, then fell off severely after President Kennedy and other Administration spokesmen emphasized the over-all effects of the business recession.

He indicated that not a single new Piper airplane has been sold in this area this year, and that sales of new airplanes of any makes could be counted on the fingers of both hands.

Beech Aircraft sales in this area in the first quarter of the year probably have been the slowest since the end of the war, a representative of one of the manufacturer's outlets here indicated, but he said that there have been definite signs of improvement in the past three weeks, with several new aircraft sales having been recorded and additional sales looking firm in the near future. Buyers appeared to be most interested in the Queen Air, Baron and Bonanza.

Excess Overhead

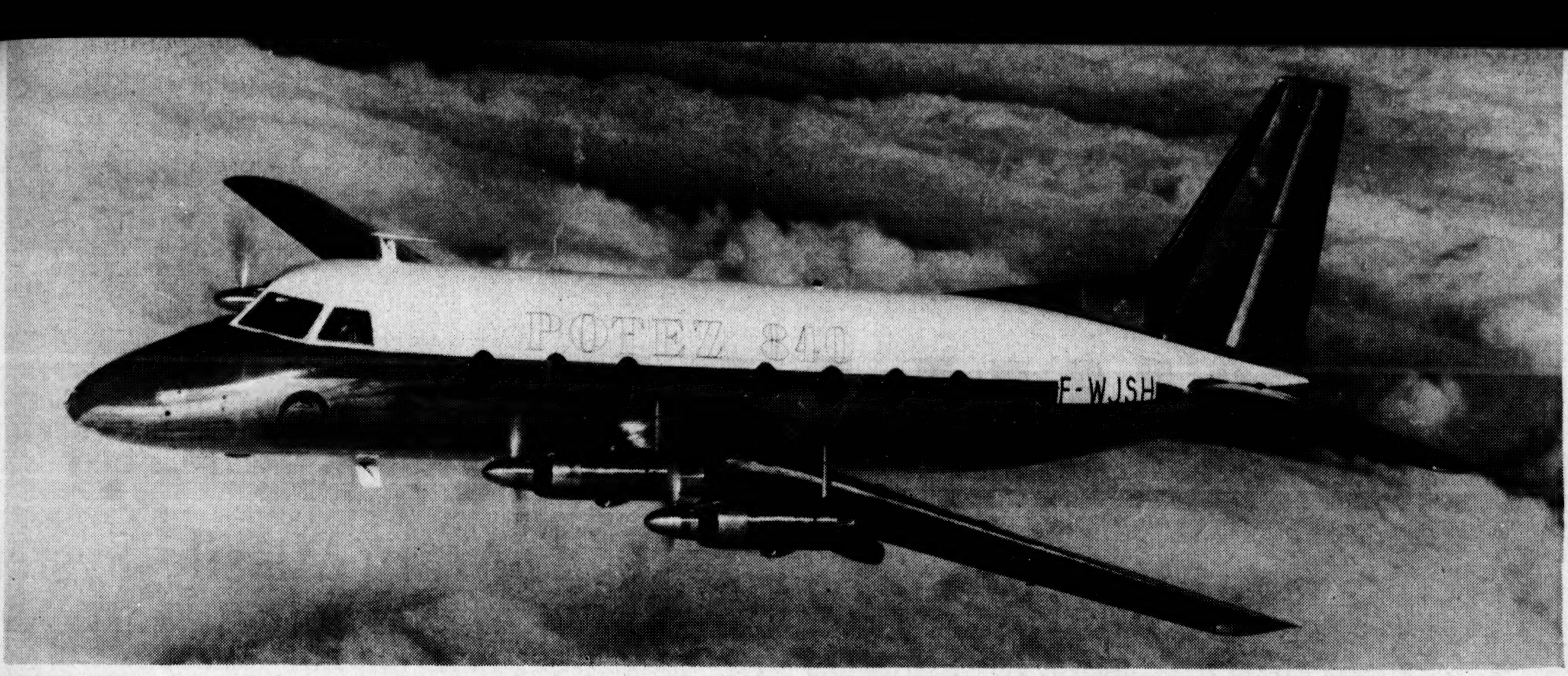
A Cessna outlet in this area reports marked movement of 1960 and used aircraft inventory—a reduction of about $100,000 in this category since the beginning of the year, but confessed that new aircraft sales had been nil. A major concern has been in reducing what he considers excess overhead, paring personnel and reducing sales costs. Lack of good customer prospects are such, he feels, that he can't afford the cost of sending salesmen door-to-door, and depends primarily upon advertising.

Much of the sales loss in this area is attributed to "over-competition—personnel breaking off from established aircraft and equipment sales and service organizations and setting up shop on the same field as their former employers. With much lower overhead, in many cases, this practice is immediately felt by the longer established outlets.

Debonair Tip Tanks Add 400 mi. Range

FAA approval of tip tanks for the Beech Debonair has been given to Flight Extenders, Inc., Stamford, Conn., builders of aircraft wingtip fuel tanks. The tip tanks are available in kit form and may be installed by any licensed fixed-base operator without making structural changes in the aircraft.

With a capacity of 12 gal. each, and an empty weight of $8\frac{3}{4}$ lb. each, the tip tanks will add approximately 400 mi. to the operating range of the Debonair.



POTEZ 840 is powered by four Turbomeca Astazou turboprop engines, each developing 522 shp. Maximum speed is 335 mph.

U.S. Market Seen for Potez 840 Turboprop

By Robert E. Farrell

Paris—Potez 840 four-engine turboprop executive/feeder airliner probably will be marketed in the U. S. by Turbo Flight, Inc., Chicago, at a price just below $500,000.

Negotiations currently are under way in Paris between Potez, the private French aircraft builder, and Don Payton, Turbo Flight president. Payton told Aviation Week he expected agreement to be reached under which his company would get exclusive North American sales rights, with an option on sales rights in South America.

In return, Turbo Flight will assume complete financing of sales and after-sales program in North America. Payton said he planned to buy a second Potez 840 prototype, slated to be completed late this year, and use it for U. S. demonstration purposes beginning in February, 1962. Production models are currently being slated for early 1963 delivery (AW Apr. 3, p. 34).

The Potez 840 made its first flight Apr. 29. The aircraft is powered by four Turbomeca Astazou turboprops each delivering 530 shp. on takeoff. As a feeder, the 840 will carry up to 24 passengers. In eight-passenger executive configuration it will cruise at about 325 mph. with a range of 1,200 mi. Operating costs, according to Payton, work out as low as 80 cents a mile, based on 600 hr. yearly utilization.

A second prototype slated for purchase by Turbo Flight will have additional range up to 2,000 mi. This will be achieved by enlarging present wing tanks and by adding fuselage tanks. Payton claims that with this range the 840's U. S. market in first year of delivery—1963—should be about 40 aircraft.

On the production side, Potez currently is dickering with the Republic of Ireland in case facilities are not found in France. The entire Potez 840 project has been privately financed by Potez since the French government is supporting the Max Holste twin turboprop feeder, the Super Broussard (AW Apr. 24, p. 103).

The Potez company itself hasn't enough productive capacity or workers to build the 840 itself. Hence it is looking elsewhere, including Ireland, where the company has production facilities in non-aviation fields. The Irish government reportedly is anxious to have Potez establish an aircraft factory in order to ease the country's unemployment problem.

Potez 840 Specifications

Span	63.8 ft.
Length	51.2 ft.
Height	17.8 ft.
Wing area	377 sq. ft.
Max. weight—24 pass.	18,740 lb.
16 pass.	17,200 lb.
Power loading	
24 pass.	9 lb./hp.
16 pass.	8.25 lb./hp.
Empty weight	10,990 lb.
Fuel capacity	407 U.S. gal.
Potez 840 Performance (Preliminary)	
Max. speed at 20,000 ft.	335 mph.
Cruising speed at 20,000 ft.	326 mph.
Takeoff rate of climb	2,360 fpm.
Takeoff rate of climb, one engine	1,440 fpm.
Ceiling	39,500 ft.
Ceiling, one engine	32,000 ft.
Takeoff roll (standard conditions)	
16 pass.	1,900 ft.
24 pass.	2,330 ft.
Landing roll (with fuel reserves)	
Over 50 ft. barrier—16 pass.	2,030 ft.
24 pass.	2,230 ft.
Power units	4 Turbomeca Astazou turboprops of 522 shp.

The Potez 840 cabin is air-conditioned and pressurized. The cylindrical fuselage is constructed on conventional frames and stringers. A slightly tapered wing has an aspect ratio of 10.75 and is fitted with double-slotted flaps with electric control. Integral wing tanks hold 420 gal.

The wing is fixed to the fuselage at four points located at the corners of a diamond. As on the company's popular jet trainer, the Magister, wing skin tapers from two to 0.8 mm. in thickness and is stiffened by ribs.

The aircraft's tricycle gear is laid out with the main gear retracting sideways into the wing, and the nosegear forward into the fuselage. Wing efficiency is aided by having the main gear doors close automatically when the wheels are in down position.

Potez factory price runs between $350,000 and $380,000. The U. S. price of $500,000 includes complete radio aids, weather radar and paid-up U. S. duty.

Turbo Flight's interest in Potez aircraft came about almost by chance. The U. S. company originally was interested in sales rights for the twin-turboprop Communaute feeder-executive prototype offered by Dassault-Sud Aviation. These two French companies dropped their project when the French government refused to help them finance it.

The first Potez 840 prototype was built in 18 months. The company decided on four engines in order to maintain satisfactory flight control by reducing unsymmetrical effects resulting from engine failures. A four-engine configuration, the company further claims, offers other benefits: ability to shut down two engines in holding patterns, to maintain higher rates of climb with an engine out and, finally, four engines give the user an extra guarantee for maintenance in operation of essential systems.

SHILLELAGH

U.S. Army Missile Syste

The **SHILLELAGH** is being developed for the U.S. Army under the over-all direction of the U.S. Army Ordnance Corps.

The United States Army SHILLELAGH surface-to-surface guided missile–like its Irish namesake–will be simple, reliable . . . lethal. Against enemy targets–moving or stationary–SHILLELAGH's accuracy and firepower will provide the U.S. Army a devastating new weapon that kills with a first-round probability approaching unity . . . and at ranges never achieved in antitank warfare. SHILLELAGH is now under development at Aeronutronic, prime contractor on this advanced weapon system.

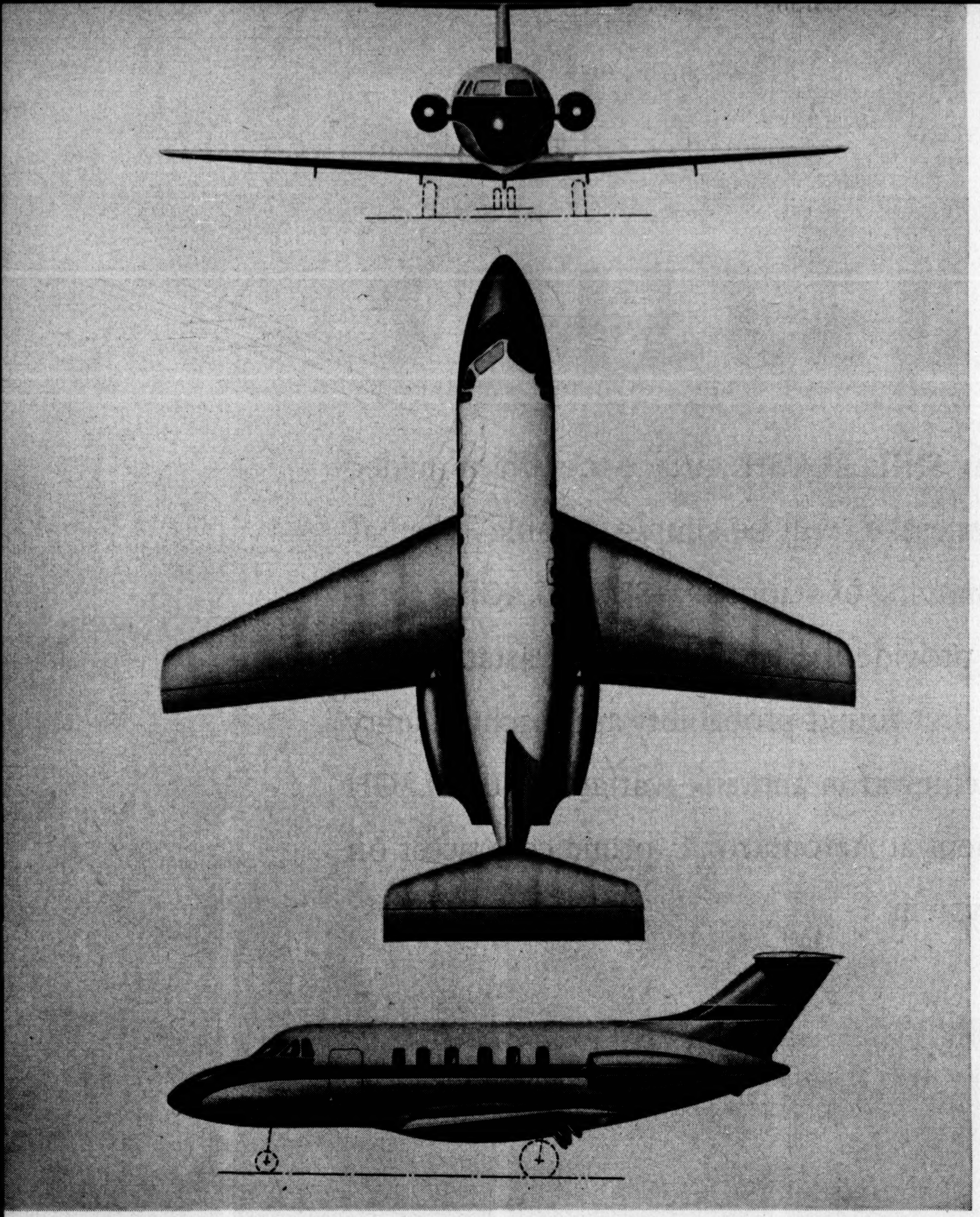
AERONUTRONIC DIVISION Ford Motor Company DEFENSE PRODUCTS GROUP
FORD ROAD, NEWPORT BEACH, CALIFORNIA

SHILLELAGH is one of many advanced programs currently under development at Aeronutronic's new, million-square-foot Engineering & Research Center at Newport Beach in Southern California.

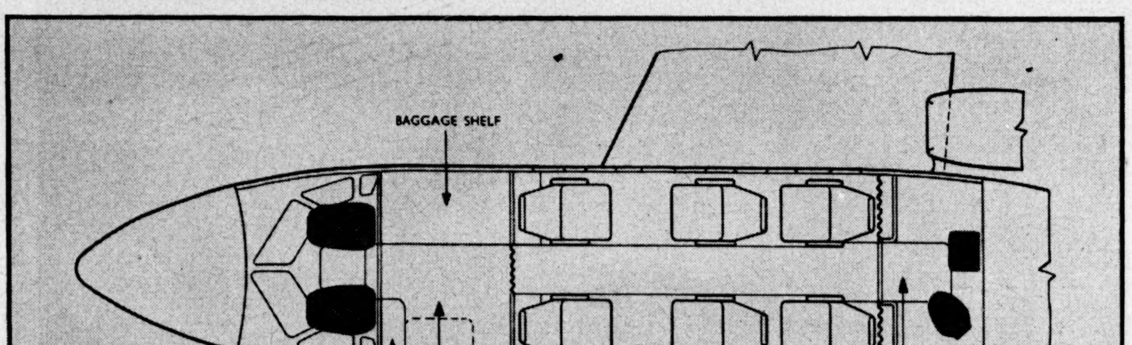
Write for information about Aeronutronic's capabilities and career opportunities now open for engineers and scientists.

De Havilland

By Herbert J. Coleman



DE HAVILLAND Jet Dragon will have a T-tail, moderate wing sweep and two Viper Mk. 20 turbojet engines (3,000 lb. thrust) mounted aft. The aircraft is designed to carry a two-man crew and six passengers (below).



London—Bristol Siddeley's Viper turbojet engine, powerplant for the new de Havilland DH.125 Jet Dragon six-passenger executive transport, has been modified to include a zero stage, boosting total thrust 500 lb. from the Mk. 11 production version.

Engine, designated Viper Mk. 20, has a thrust of 3,000 lb., compared with 2,500 lb. produced by the Mk. 11 version, and mass flow has been increased from 44 lb./sec. to 52.8 lb./sec. Specific fuel consumption has been cut from 1.07 lb./hr./lb. to 0.985 lb./hr./lb.

The Jet Dragon, first de Havilland entry into the pure jet executive field, will go into production directly from the design stage (AW Apr. 17, p. 33) and a mockup now is under construction at de Havilland's Hatfield facility. Engines are mounted aft on the fuselage section.

By adding the zero stage on the front of the compressor section, Bristol Siddeley said it also has improved turbine performance by decreasing turbine entry temperature 25C to about 1,115K. Further developments may include a two-stage turbine and an aft fan to extend application of the engine. Mk. 11 version, which powers the Macchi MB.326 trainer, has seven-stage compressor driven by a single-stage turbine with an annular combustion chamber of the vaporizing type. Mk. 20 now is flying in the Hunting Jet Provost and Macchi for operational experience data.

Engine has been used in various marks of the Jindivik target drone, the Jet Provost trainer, Dassault Mirage, the Bell X-4 V/STOL research plane and the Sud Aviation Trident interceptor.

De Havilland will build an initial quantity of 30 Jet Dragons, but has not yet revealed the price or performance details. It probably will cost in excess of $400,000 and is designed to carry a two-man crew and six passengers on stages up to about 1,500 mi. at speeds up to 500 mph.

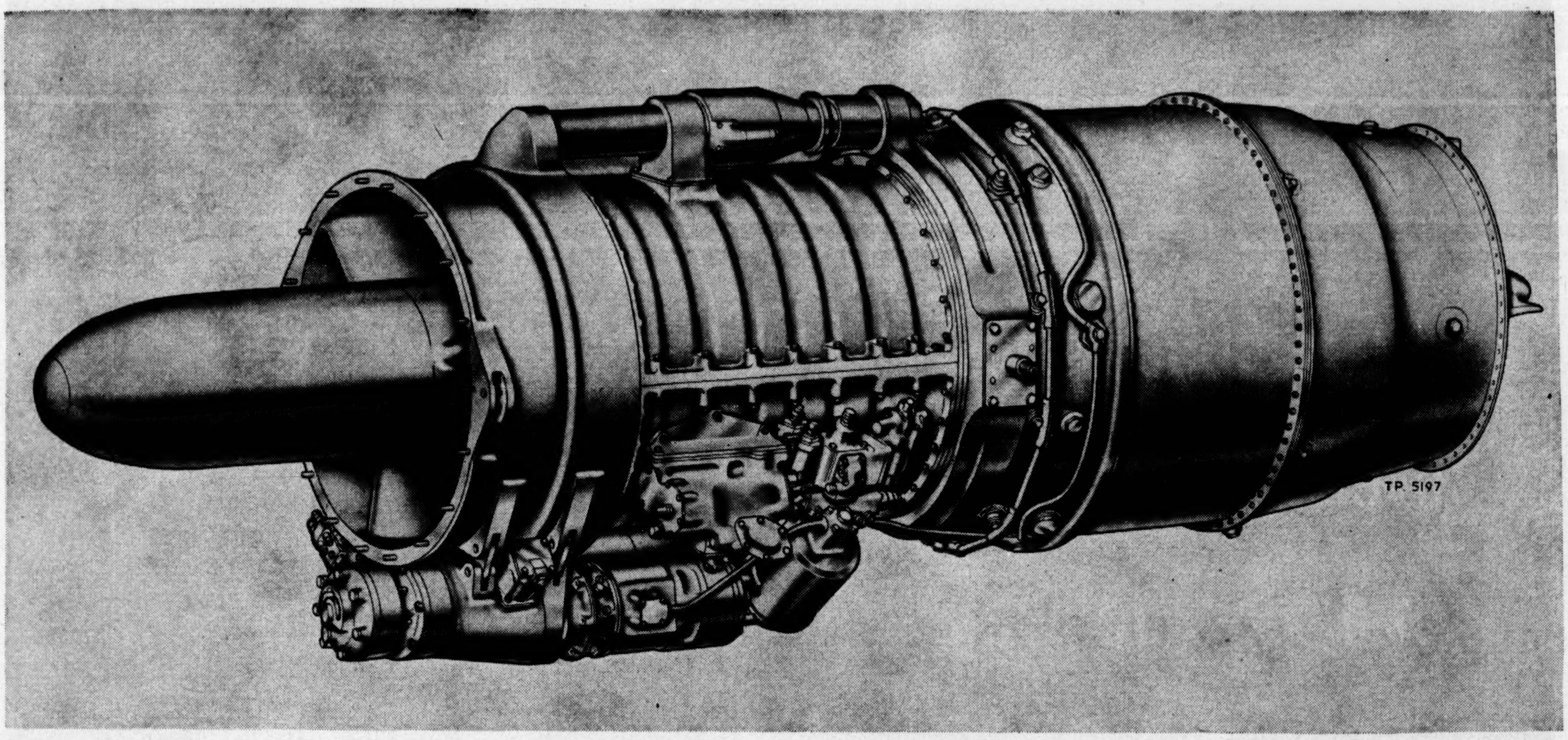
Jet Dragon configuration, with its T-tail and aft-mounted twin jets, is similar to the de Havilland Trident and BAC 107 transport lines. The com-

De Havilland DH.125

Specifications

Length	42.5 ft.
Span	44 ft.
Height	14 ft.
Wing Area	342 sq. ft.
Gross Weight	18,000 lb.

Modifies Engine for DH.125 Executive Jet



VIPER MK. 20 for DH.125 weighs 575 lb., is 66.67 in. long. Projected follow-on, aft-fan BS.86, would have 3,700 lb. thrust.

pany will submit the airplane to the British Air Ministry for possible use as a small transport and jet trainer for air crews. First order would be for 50 Jet Dragons, but the Ministry is known to be waiting for the first plane to fly before making any move.

De Havilland is financing the project with its own funds, for delivery to customers in 1963, and has allocated "several million pounds" for development of an aircraft it believes will remain current for 20 years.

Major factor in the design effort has been to keep the Jet Dragon capable of operating from short runways and at "very moderate" approach speeds, but retaining good handling characteristics at both high and low speeds.

Engineers said the construction has been kept simplified; fuselage is being built in one piece, parallel over a substantial portion of its length. It will have an uninterrupted circular cross section. Wing will be built as a single unit from tip to tip, and it will pass unbroken under the main fuselage section.

Top surface of the wing will be dished to receive the fuselage. The wing has a moderate degree of sweep and is fitted with double slotted flaps. Speed brakes also will be installed. Controls will not be power-boosted because maximum cruising Mach number will not greatly exceed 0.7.

Gross weight is about 18,000 lb. The company says that on the basis of aircraft miles flown, costs of operation of the Jet Dragon will be almost the same as those of the piston-powered Dove, or about 30 cents per mile.

De-icing equipment will be fitted to the Jet Dragon, and Bristol Siddeley has provided a de-icing system for the Viper, in line with the all-weather requirement.

The Jet Dragon is the 125th airplane designed by de Havilland, hence its number designation. It is named for the 1932-vintage DH.84, first de Havilland twin-engine transport.

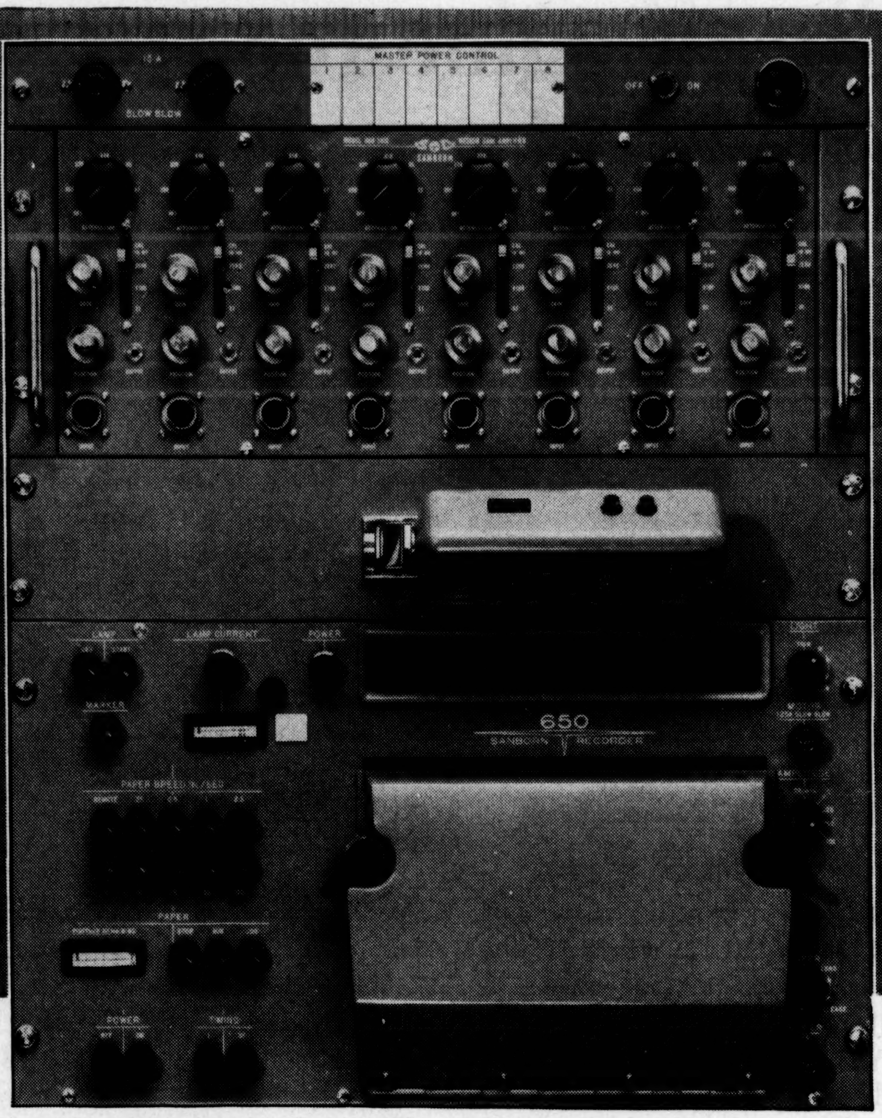
U.S. Business & Utility Aircraft Shipments

(March, 1961)

Make & Model	No. of Units	Net Billings
Aero Commander 500A, F	8	$1,405,000
560E, F	5	
680E, F	5	
Beech 18 Super	5	$3,929,000
33 Debonair	21	
35 Bonanza	27	
50 Twin-Bonanza	5	
55 Baron	21	
65 Queen Air	5	
Callair A-5	2	$30,000
A-6	1	
Cessna 150	23	$2,925,000
172, Skyhawk	63	
175, Skylark	7	
180	9	
182, Skylane	45	
185, Skywagon	13	
210	16	
310	16	
Lake LA-4	1	$27,000
Mooney Mark 21	21	$356,000
Piper PA-18-150 Super Cub	13	$3,452,000
PA-22 Tri-Pacer	3	
PA-22 Colt	169	
PA-23 Apache	9	
PA-23 Aztec	21	
PA-24 Comanche 180	20	
PA-24 Comanche 250	54	
PA-25 Pawnee	19	
Totals	531	$12,124,000

Note: Total U. S. business and utility aircraft shipped in first quarter of 1961 numbered 1,812 units having a gross factory billing of $35,287,000—this compares with 2,333 units having a gross factory billing of $44,633,000 shipped in the same period last year. March shows a noticeable pickup in deliveries over February, although it is still below January's 654 units and traditionally in this industry March should be one of the year's strongest months in deliveries and dollar volumes. All companies listed above showed a noticeable pickup in deliveries and dollar volume compared with their February deliveries except Cessna. However, indications are that the industry will show a marked upward response in May in shaking off the effects of the recession. Cessna has rehired some 100 workers laid off in a production cutback earlier this year in preparation for an increase in output expected in the next few months.

DC to 5000 cycles over an amplitude of 4" peak to peak



NEW SANBORN "650" SYSTEM OFFERS DIRECT READOUT, 8 TO 24 CHANNELS, ALL SOLID STATE CIRCUITS, FOR RACK MOUNTING OR INDIVIDUAL CASES.

Here's the *one* system that lets you record inputs from DC to 5 KC within 3 db at 4" peak-to-peak amplitudes, without changing galvanometers. The "650" system consists of an 8-channel medium gain, general purpose amplifier unit driving a high speed, high resolution optical oscillographic recorder. It can be easily built into your system, packaged in a mobile cabinet or housed in individual cases. The single-chassis, 7" high amplifier module has 8 separate channels, *complete from floating and guarded inputs to galvanometer outputs;* each channel comprises a front end modulator and input transformer, carrier amplifier, demodulator, filter and driver amplifier. Power Supply and Master Oscillator Power Amplifier are built-in. All amplifier elements are plug-in transistorized units for easy servicing.

Immediately readable recordings are made on 8" wide daylight-loading ultra-violet-sensitive charts which require no chemical development. Features of the 12¼" high recorder unit include 9 electrically controlled chart speeds from ¼" to 100"/sec; calibrated monitoring screen; automatic trace identification and timing lines at 0.01 or 0.1 sec. intervals; amplitude lines spaced 0.1" apart which can be blanked from ¼, ½, ¾ or all of chart. Recorder is available with an 8-, 16- or 24-channel galvanometer block which is then equipped with the number of galvanometer elements desired by the customer. Both the Recorder and Amplifier are also available as individual units for use with other equipment.

SENSITIVITY 20 mv input gives 8" deflection; 12 attenuator steps to X5000, smooth gain control.

INPUT RESISTANCE 100,000 ohms all ranges, floating and guarded; DC source resistance must be kept below 1000 ohms on mv ranges only.

COMMON MODE PERFORMANCE Rejection at least 140 db at DC, tolerance to ±500 volts, max.

GAIN STABILITY Better than 1% to 50° C. and for line voltage variation from 103 to 127 volts.

LINEARITY 1½% of full scale (8 in.)

NOISE 0.02" peak-to-peak, max.

MONITOR OUTPUT On front panel; provides ±1v full scale across 100,000 ohm load

POWER REQUIREMENTS 103-127 volts, 60 cycle AC; 625 watts

Contact your Sanborn Sales-Engineering Representative for complete specifications and applications engineering assistance. Offices throughout the U. S., Canada and foreign countries.

SANBORN COMPANY
INDUSTRIAL DIVISION
175 Wyman St., Waltham 54, Massachusetts

AVIONICS

Ultra-High Speed Computer Investigated

By Barry Miller

Los Angeles—Techniques which may be employed in the ultra-high speed military computer systems that are going to be needed to process large volumes of data in relatively short periods of time were discussed here recently at the Western Joint Computer Conference.

The need for thorough investigation of techniques and components for high speed systems, operating in the kilomegacycle region, prompted at least one agency—the Office of Naval Research—to support studies of microwave computers at Radio Corp. of America, International Business Machines Corp. and Sperry Rand Corp. under its Project Lightning (AW Dec. 28, 1959, p. 72). Devices capable of operating at nanosecond or higher speeds might be invaluable in applications such as analysis of ballistic missile defense data or weather prediction.

A few of the problems encountered in building nanosecond computer systems as part of Project Lightning were described by Edward Luedicke of RCA's Semiconductor and Materials Division in Somerville, N. J. At the high speeds (1,000 mc. frequency) explored in the RCA work, the electrical interconnections become an overriding consideration. For at these high switching speeds the interconnections are no longer short with respect to the shorter wavelengths and wiring delays become significant. They have to be treated, Luedicke says, as a communication network in which wiring, delays, crosstalk and waveform distortion are design considerations so that the final speed of the computer is not affected appreciably by the time it takes for proper distribution of internal signals.

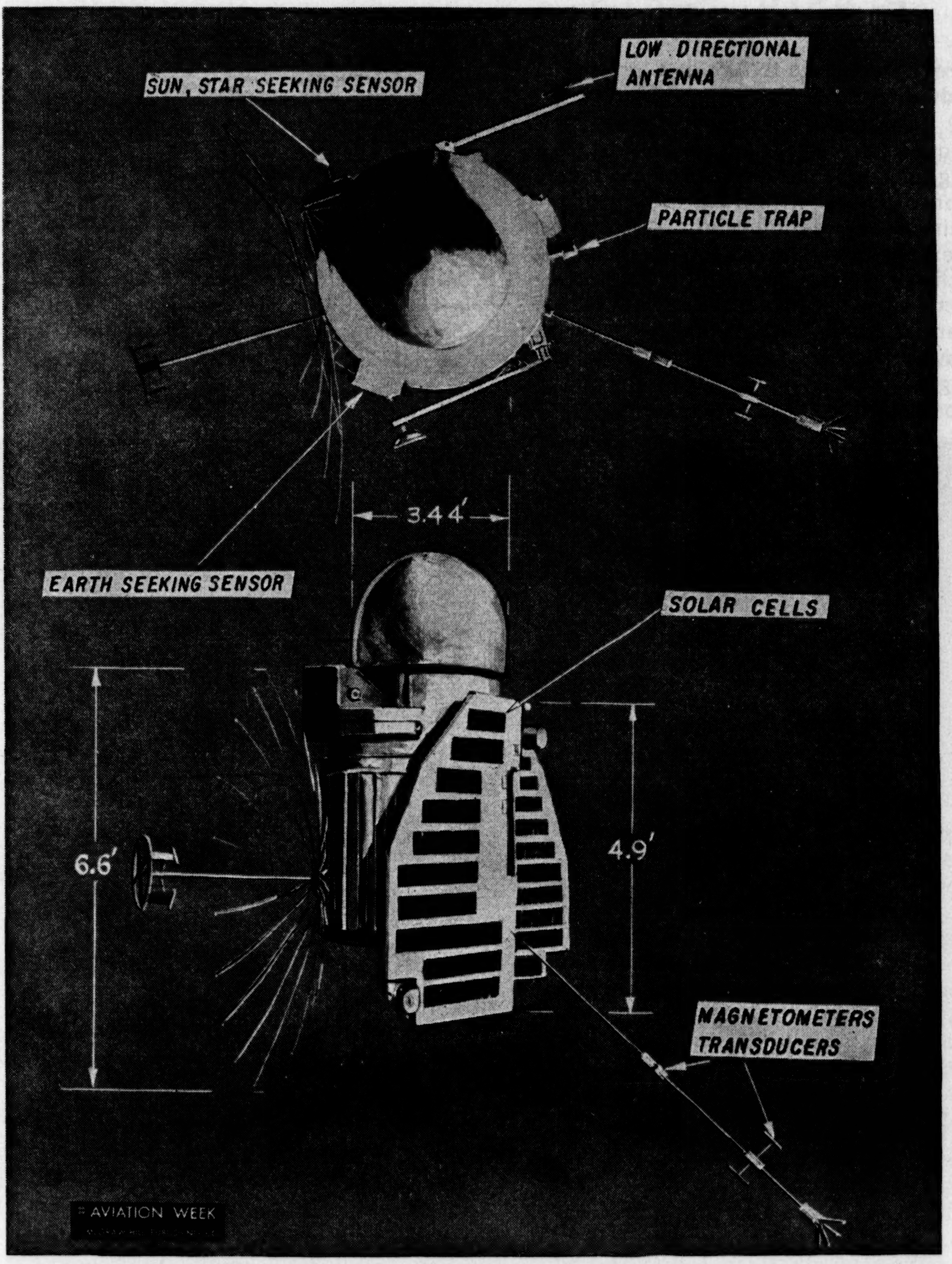
The possibility of sidestepping the interference problem created in the microwave region by the tendency of interconnecting wires to behave as energy radiators was explored in a report on optical computers and quantum transition memory devices presented by Lewis C. Clapp of the Computer Development Lab. of Sylvania Electric Products, Inc., Needham, Mass.

Clapp stressed that many of the ideas on optical computers expressed in his report were based not on actual experiments but on theoretical considerations which might not prove too practical. At least several other laboratories are studying the areas covered in Clapp's talk and may be investigating some of the techniques which he examined.

It may be possible, he pointed out, to transmit information at rates in excess of a million pulses per second without generating interference on neighboring channels. This may be done, he indicated, by transmitting data in the form of optical waves—infrared, visible light or ultraviolet—as these wavelengths can be transmitted free of noise by isolation techniques which are comparatively simple.

Entering into the optical region requires, however, substitutions for a number of elements employed at conventional speeds. The components for such an optical computer, Clapp suggests, might be realized as follows:

- **Storage devices**—For storage elements, corresponding to cores or flipflops in conventional devices, the designer might tap the quantum mechanical properties of radiation in solids



Soviet Probe Passes Venus

Soviet Venus probe, now silent, passed within 62,500 mi. of Venus about May 20. The 1,419-lb. probe was launched from orbit from Sputnik VIII Feb. 12. Chemical batteries charged by the solar cells power the instrumentation and telemetry. Probe's transmitters, operating on 922.8 mc., have failed to respond to ground command since Feb. 27, but Russia will continue to attempt to re-establish contact with the payload (AW Mar. 20, p. 33). Sputnik VIII mother ship re-entered the atmosphere and burned Feb. 25.

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or gases. Possibly, he said, the ground state and excited energy levels of an atom could be used as storage positions with switching between logical conditions being optically induced transitions from one energy level to the next. Transition times between energy levels frequently are on the order of a nanosecond or shorter. Still faster switching times might be attained, Clapp said, by using electron spin resonance techniques.

- **Transmission lines**—Light pulses might be transmitted from point to point within the computer by optical fibers, much as electrical pulses are passed between points in a conventional computer by wires. Attenuation down the fibers would be small when coated with a glass whose lower refractive index would reduce or eliminate cross talk.
- **Decision elements**—Decision-making elements, such as diode gates and core logic might be obtained by combining two beams of circularly polarized light. Three types of polarized light beams—linear, circular right and circular left—might be used to generate ternary rather than binary logic. A Kerr cell could function as a gate to convert an electrical impulse to an optical signal and a photocell might be satisfactory for translating optical signals into the electrical pulses with which to excite output equipment.

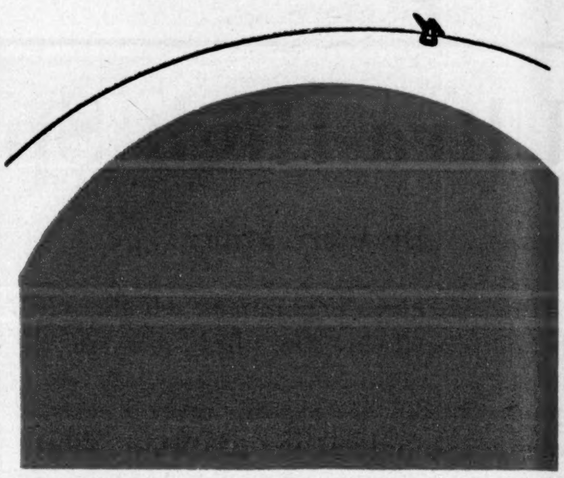
Storage Device

One simple storage device employing quantum transitions in a gas was described by Clapp. A small vessel with two electrodes encapsulates two gases—one with known metastable states, the other with an ionization potential below the metastable state energy. When the gas atoms are in a normal energy distribution, most of their atoms in the lowest energy or ground state, the cell is regarded to be in the logical "zero" state. If a voltage pulse is then applied to the cell it will cause free electrons, made available by the ionization of one gas, to excite the atoms of the other gas into higher energy states. Some of these will drop down into the metastable state, remaining there until a read pulse is applied to drop them to the ground state. In the process, they emit radiation.

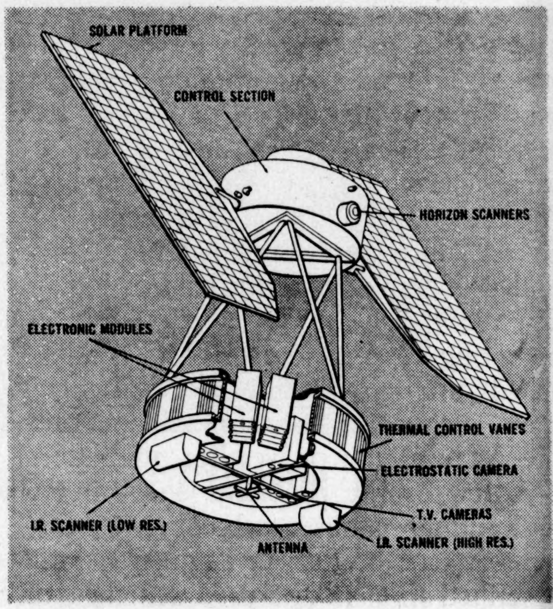
If the cell were in the "zero" state during interrogation, Clapp points out, the energy level of the ground state electrons would be shifted slightly without producing significant radiation.

The same effect might be brought about, Clapp continued, by admitting radiation into the cell to stimulate transitions to the upper energy levels and then inducing transitions of trapped electrons back to ground. This latter technique is simpler than the first.

Several gaseous memory cells could



NIMBUS



Nimbus is the second step in NASA's research and development program to study weather technology. Differing from its predecessor, Tiros, Nimbus will view the Earth at all times.

Orbit—Weighing approximately 650 lbs., Nimbus will circle the earth every 108 minutes in a 600 mile-high polar orbit.

Equipment—As many as 6 TV cameras, plus infrared measuring devices, tape recorders, telemetry and command instruments will be contained in the satellite.

Data Acquisition—Cloud pictures and other information will be played back on command to U.S. meteorologists at Fairbanks, Alaska. Foreign scientists, also, will be invited to participate in the program.

Control and Stabilization—A specially built system will keep TV cameras always oriented toward the earth and permit cameras to view particular sectors of the global cloud pattern.

General Electric's Missile and Space Vehicle Department will provide systems integration for Nimbus, and will develop the control and stabilization system. MSVD is a department of the G.E. Defense Electronics Division. 160-03

GENERAL ELECTRIC

be assembled into a large memory by joining two glass plates in a gaseous environment so that the upper plate, containing many spherical half cavities, encloses the gas. The lower plate contains electrodes for exciting the gas in each cavity during read and write. The radiation output which occurs when a stored logical one is detected can be fed out through optical fibers to a photocell associated with a particular group of bits, Clapp indicated.

The same phenomena in a solid material might be preferred, Clapp said, in place of a gaseous system which has certain technological problems, combined with the need for suppressing spurious transitions from upper energy levels to ground state produced by collisions of atoms.

There are a number of color centers in different ionic crystals which deserve further study as potential mechanisms suitable for data storage. One of these, Clapp suggests, is the F center, generally thought to be a lattice point with a missing negative ion. Electrons tend to be trapped by the resulting vacancy but are rather loosely bound so that they can be freed by external radiation or heat.

The dynamics of a memory cell utilizing F center trapping might be as follows: Electrons might normally be below the Fermi level in the crystal band structure, thus below the F center as well. This could be designated the "zero" state. By illuminating the crystal, electrons are brought into the conduction band, and if the F center density is sufficiently high, a significant number of electrons would be trapped. The state of the memory, Clapp said, could be detected in several ways. For example, the crystal could be irradiated with short wavelength radiation or an electric field could be applied and then transition radiation could be observed as electrons return to valence band.

Another type of memory element might employ an optical maser with a large number of cells for data storage.

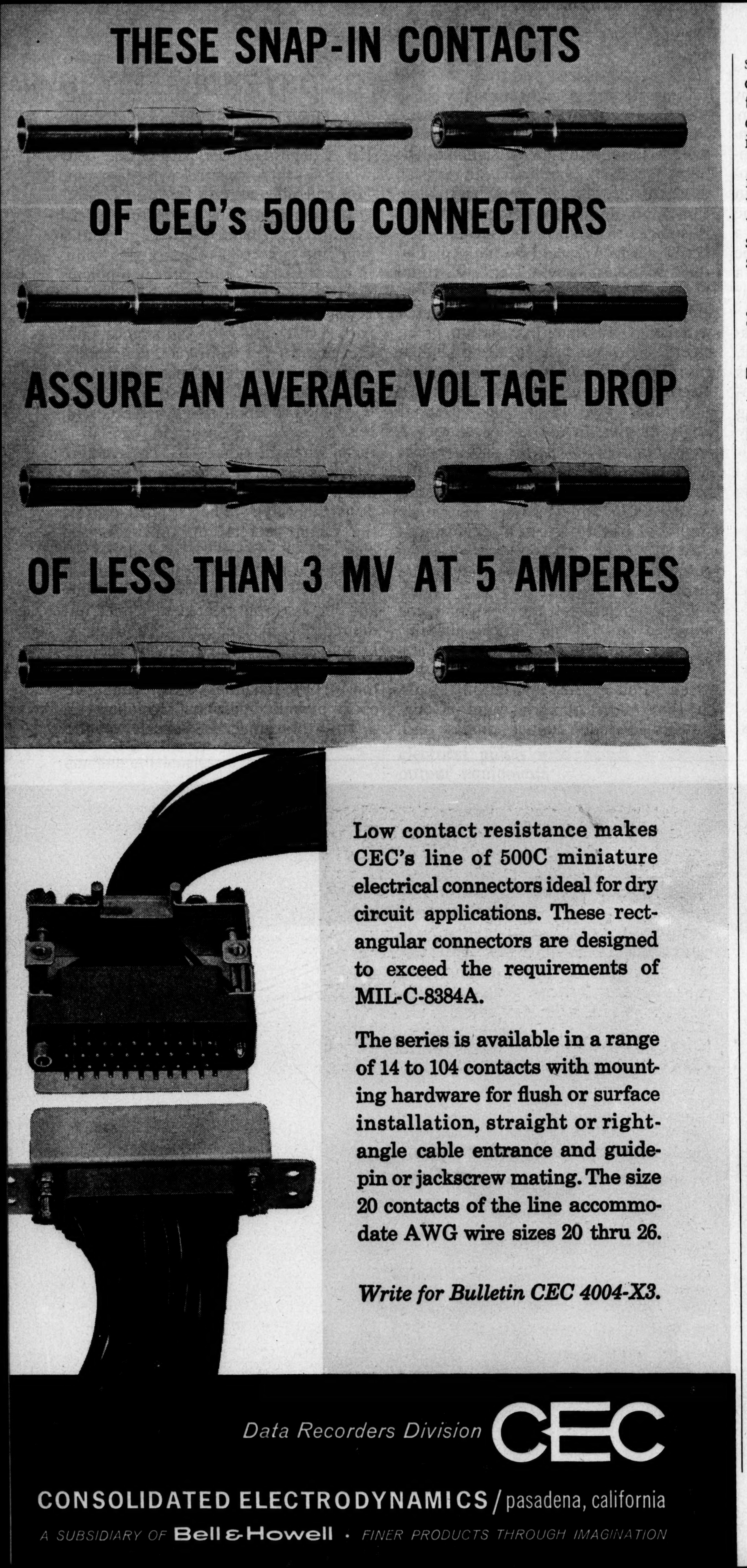
In his report, co-authored with Albert H. Medwin, Luedicke outlined the construction and testing techniques employed in the logic and memory circuits of a 1,000-mc. tunnel diode computer developed under Project Lightning.

Logic circuits for the computer are mounted on 20-mil thick alumina wafers whose tentative dimensions are 775 by 400 mils. Interconnections between wafers are made to terminal pads on three sides of each wafer. Components include tunnel diodes and specially developed precision ceramic rod resistors, 20 mils in diameter and 100 mils in length. Resistive material is deposited over part of the body which is then covered with inorganic film and silicone resin for protection.

In interconnecting wafers in a special assembly, a shielded coaxial transmission line concept was pursued to minimize crosstalk and other problems peculiar to a microwave computer. The transmission line provides a physical path with uniform inductance and capacitance per unit length thereby avoiding other disturbances the techniques may cause at these frequencies.

The RCA approach, Luedicke said, was to insert an insulated wire in a metal channel of a slab-like structure which is made with two or more channel patterns. This structure also supports the wafers. The terminal pads of the circuit wafers line up with the channels so that each wire is in its channel until reaching the terminal. Physically, the channels are laid out and the assembly treated to reduce undesired electrical effects. Crosstalk is minimized, he pointed out, by keeping each wire in its channel. Coating the top of the channel with conductive epoxy provides additional shielding.

To avoid undesired effects of the



THESE SNAP-IN CONTACTS OF CEC's 500C CONNECTORS ASSURE AN AVERAGE VOLTAGE DROP OF LESS THAN 3 MV AT 5 AMPERES

Low contact resistance makes CEC's line of 500C miniature electrical connectors ideal for dry circuit applications. These rectangular connectors are designed to exceed the requirements of MIL-C-8384A.

The series is available in a range of 14 to 104 contacts with mounting hardware for flush or surface installation, straight or right-angle cable entrance and guide-pin or jackscrew mating. The size 20 contacts of the line accommodate AWG wire sizes 20 thru 26.

Write for Bulletin CEC 4004-X3.

Data Recorders Division CEC

CONSOLIDATED ELECTRODYNAMICS / pasadena, california

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same signals arriving at two points at different times, two wires can be cut to the longest length and the excess wire on the shorter path run back and forth in its channel.

Measurements—including characteristic impedance, crosstalk and loss—were made and found to compare favorably with measurements made in a solid piece of silver-plated brass of the same configuration.

FILTER CENTER

▶ **USAF Airborne Avionics Analyzed**—Air Force aircraft and non-ballistic missiles now in the inventory have an average of 16 avionic subsystems per vehicle and each subsystem has an average of 97 circuits, according to statistical analysis made by Melpar and reported by William Metzger during recent National Aerospace Electronics Conference (Naecon) in Dayton. Analysis of circuits, their functions and characteristics was made to provide guidelines for future molecular electronics developments. Second phase of USAF-sponsored program will analyze airborne avionics equipments now under development. A breakdown of circuit types now in use, by per cent of weighted circuit population, is as follows:

- 42.6%: Amplifiers.
- 14.9%: Pulse and wave shaper.
- 13.9%: Logic.
- 12.1%: Frequency translator.
- 8.6%: Oscillator generator.
- 4.9%: Filter.
- 2.5%: Memory and scaling.
- 0.5% Miscellaneous.

▶ **USAF Hedges Molectronics Bets**—Although Air Force has lost none of its enthusiasm for molecular electronics (molectronics), a concept which it and Westinghouse Electric pioneered, the USAF recognizes the need for microcircuits using discrete components and integrated component assemblies at least as an interim step to achieve sizes and weights required for space vehicles.

▶ **Recent Molectronic Advances Reported**—Recent developments in molectronic FEBs (functional electronic blocks) reported by Westinghouse Electric's H. W. Henkels at recent Naecon include the following:

- **Tuned amplifier,** using amplifier with a notch filter in a degenerate feedback look, instead of the conventional tank circuit, has given "Qs" of as high as 300. The entire device occupies a size of only $\frac{1}{2}$ x $\frac{1}{4}$ x 0.004 in.
- **High level amplifier,** three stage, providing current gains up to 10,000 has been constructed.
- **Video amplifiers,** with responses to 3 mc.

▶ **Optical Pulse Expander Developed**—Optical device for expanding and compressing radar pulses on a pulse-to-pulse real-time basis, using a coherent light processing technique, was reported at Naecon by Leo Slobodin and Alfred Reich of Lockheed Electronics Co. In one experiment described by the Lockheed scientists, a 0.5 microsecond input pulse was expanded to 55 microseconds using a 15-mc. intermediate frequency carrier and a 2.5-mc. IF coded bandwidth.

▶ **Improved Solar Cells Developed**—Gallium arsenide solar cells, which have a higher theoretical conversion efficiency than present silicon cells, have achieved efficiencies up to 14.7% in laboratory samples, R. W. Runnels of the Aeronautical Systems Division's Electronic Technology Laboratory reported at Naecon. Samples were in 3-cm. square sizes. Another promising solar cell development is the use of new polycrystalline materials, such as cadmium telluride, which can be fabricated in large structures at relatively low cost, Runnels said. New ternary compounds, such as aluminum antimonide, which are most responsive to solar energy in the 0.2 to 2.0 micron region where the sun's energy is strongest, also are under investigation.

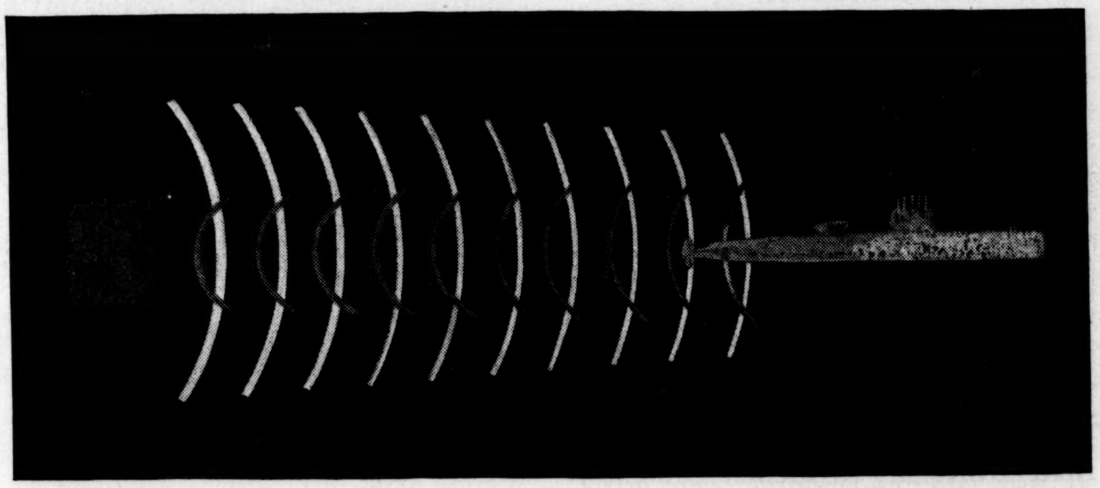
▶ **High-Power Magnetron Progress**—Magnetron, which uses a novel inverted coaxial structure, has produced 380 kw. peak power at a frequency of 16 kmc., and 125 kw. at 36 kmc., in laboratory tests, Lt. M. M. Heil of ASD's Electronic Technology Laboratory reported to Naecon.

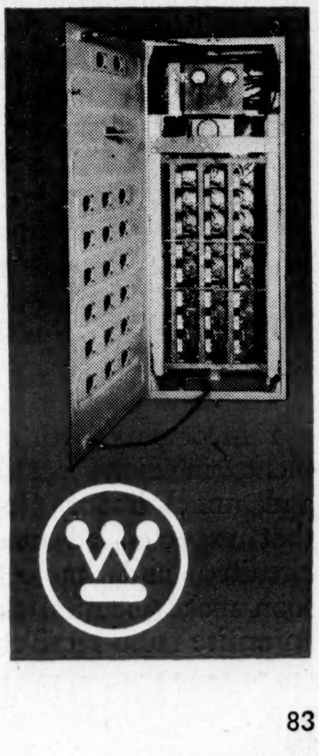
▶ **New Type Solid-State Device**—New active four-terminal solid-state device, whose operation depends upon its capacitance vibration rather than upon current carriers as in conventional transistors, was described at Naecon by Charles F. Pulvari of Catholic University, Washington, D. C. Device, called a solid-state electrometer, can be used for sensing mechanical movements without physical contract, for detection of electrostatic recordings and as an instrument for dielectric, capacitance, Hall effect and charge pattern measurements, Pulvari said. The vibrating capacitance is created by back-biasing a diode junction using a voltage provided by a tunnel diode oscillator.

▶ **Melpar Picked as Minuteman Supplier**—Melpar, Inc., was selected by Autonetics as the second supplier of circuit boards for the inertial guidance/control system for Minuteman. Melpar was chosen from 27 firms seeking the role (AW Apr. 24, p. 83). Autonetics is associate prime contractor on Minuteman.

NEW FROM WESTINGHOUSE:

STATIC POWER SUPPLIES FOR SONAR





Static power packages from Westinghouse supply unfailing power for sonar. In unit shown at right, which will power sonar for Edo Corporation, modular packaging permits replacement of 13 diodes per unit in less than *one* minute. Ratings to meet any system range or performance can be supplied. This equipment meets Mil P-15736. For help in solving your static power supply problems, just contact your local Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

J-92503

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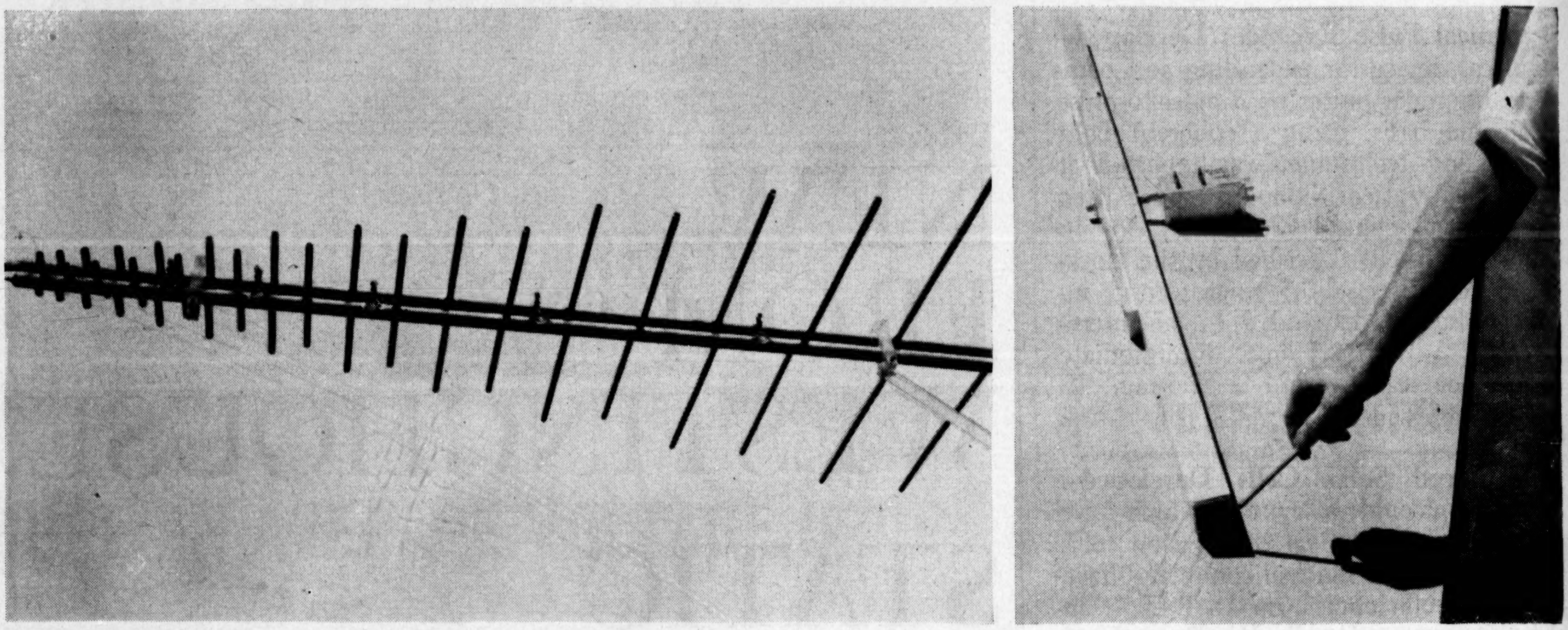


NOVEL COMBINATION antenna-amplifier, in which RF amplifier (or heterodyne converter) is built as integral part of antenna structure is shown in two different types. Log-periodic dipole with tunnel diode distributed amplifier (left) was developed by Ohio State University scientists; the half-wave dipole (right) using a solid-state parametric amplifier was developed by scientists at New Hampshire University.

Antenna Has Built-in Receiver Circuitry

By Philip J. Klass

Dayton, Ohio—Antenna for communications, telemetry and radar which has part of the radio receiver circuitry integrated into the antenna's structure, providing improved performance and reduced system size, was disclosed here during the recent National Aerospace Electronics Conference.

The new technique is expected to find use in satellites and space vehicles where performance, size and weight are critical factors, as well as in terrestrial applications.

An antenna which contains a heterodyne diode converter that produces an output at an intermediate frequency, called an "antennaverter," and one whose structure contains a diode distributed preamplifier, called an "antennafier," were among the novel types described by John R. Copeland of Ohio State University's Antenna Laboratory. (The report was co-authored by William J. Robertson, also of Ohio State.)

A similar technique, in which a solid-state parametric preamplifier is built into the structure of a half-wave dipole element of a Yagi antenna for a satellite doppler tracking station (at 108 mc.) was described by Albert D. Frost of the University of New Hampshire's Antenna Systems Laboratory. (The report was co-authored by Ronald R. Clark.)

The new concept in antenna design is a direct outgrowth of recent developments in diode parametric amplifiers and tunnel diodes. Copeland predicted that expected advances in solid-state circuitry and molectronics "should soon make practical the integration of an entire radio receiver, except perhaps for the output display, into the antenna structure."

Working under the sponsorship of USAF's Aeronautical Systems Division in Dayton, Ohio State University scientists have investigated a number of different types of integrated antennas, including the following:

- **Broadband spiral antenna** with a mixer or tunnel diode that functions as a heterodyne converter to deliver the received signal at a new intermediate frequency.
- **Traveling wave antenna** in combination with a traveling wave tunnel diode amplifier.
- **Log-periodic dipole array** in combination with a tunnel diode distributed amplifier.
- **Parasitic beam antenna** whose resonant elements are used as tank circuits for a tunnel diode amplifier.

Antennaverter Tests

For Ohio State's tests, an antennaverter was built into the feed terminals at the tip of a conical spiral antenna. The arms, or radiating elements of the spiral, were the outsides of two coaxial cables while the cables themselves served to bring in the local oscillator signal and take out the intermediate frequency (IF) signal.

By varying the frequency of the local oscillator, the antenna effectively is tuned to any desired frequency over its bandwidth.

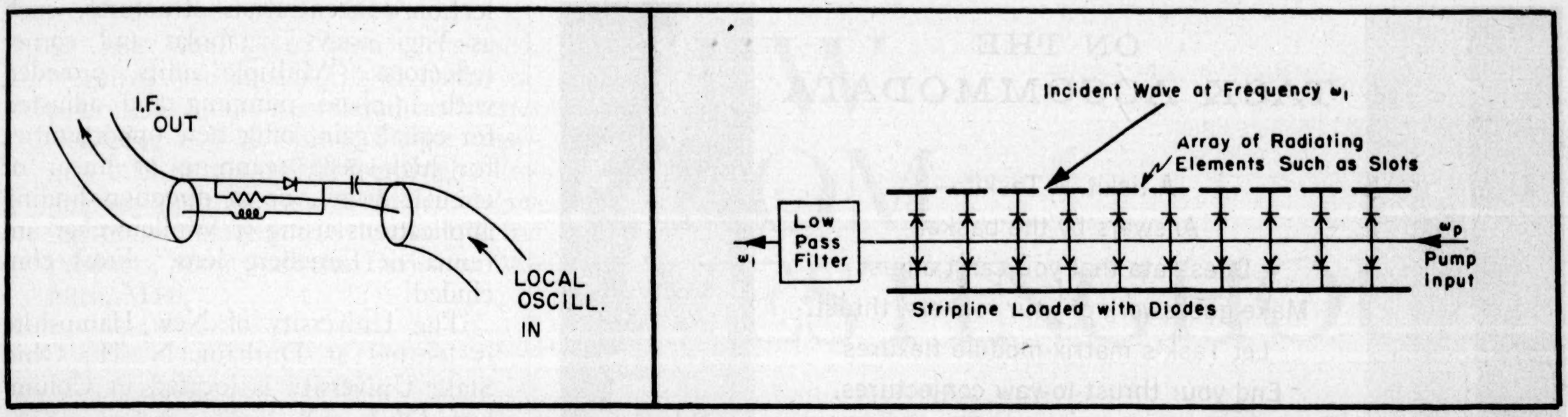
The Ohio State tests indicated that the antennaverter equipped with a conventional mixer diode (Type IN832) has approximately the same noise figure as a laboratory standard (General Radio) coaxial mixer. Using a tunnel diode, the device exhibits a 7-db. gain over its performance with the IN832, Copeland said. The gain with signal conversion occurs because of the tunnel diode's negative resistance characteristic.

The traveling wave parametric antennafier approaches the ideal type of preamplifier by distributing the amplification along the length of the antenna structure itself. This provides extremely low-noise operation because amplification occurs at the point of signal reception without the usual transmission losses that occur as the signal travels out to an external receiver/preamplifier, Copeland said.

The traveling wave antennafier can use variable capacitance diodes or tunnel diodes. In a conventional traveling wave amplifier using tunnel diodes, ferrite isolators generally are required to suppress the backward-traveling wave caused by mismatch which otherwise causes instability. But in the tunnel diode antennafier, this backward wave is radiated from the antenna structure and the isolation problem is eliminated or greatly reduced, Copeland said.

Ohio State scientists also constructed a log-periodic dipole array antennafier using tunnel diodes installed in the feeder line into which the stub elements connect. Preliminary measurements indicate a net gain of 3 db. per diode in the active region of the antenna and an improvement in noise figure similar to that obtained with the antennaverter. Work currently under way is aimed at determining the optimum configuration and methods of biasing the tunnel diodes.

Copeland also described a resonant half-wave dipole with a gamma-match


I.F. OUT
LOCAL OSCILL. IN
Incident Wave at Frequency ω_1
Array of Radiating Elements Such as Slots
Low Pass Filter
ω_1
ω_p
Pump Input
Stripline Loaded with Diodes

SPIRAL "antennaverter" (left) consists of combination broadband spiral antenna and a mixer or tunnel diode which converts incoming signal to intermediate frequency output. Traveling-wave parametric "antennafier" (right) is used in log-periodic dipole array.

arrangement for adjusting the impedance seen by the tunnel diode. The gamma-match provides sufficient range of adjustment so that the antennafier can be made to oscillate at the dipole's resonant frequency and usable modulated signals have been radiated from the device, Copeland said.

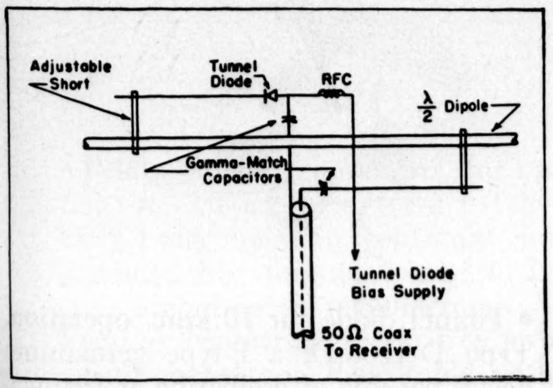
Supergain Structure

If the gamma-match is adjusted so that oscillations do not occur, the antennafier resembles a conventional tank-type tunnel diode amplifier and arrays of such elements can be used to form highly directive antennas, Copeland said. "It appears that a practical supergain structure could be built, with the necessarily violent amplitude distributions obtained by adjusting the gains of the individual antennafier elements," he said.

Continued work with the new techniques should provide "great improvements in receiving systems, both large and small, and may be extended to transmitting systems as well," Copeland concluded.

Par-Amp Antennas

The University of New Hampshire scientists, working under the sponsorship of the Air Force Cambridge Research Laboratories, constructed a varactor diode parametric amplifier within the structure of both a 108-mc. half-wave and a 54-mc. quarter-wave dipole. Input signal for the parametric amplifier is derived directly from the signal induced potentials at the ends of the dipole.



PARASITIC beam antenna whose resonant elements are used as tank circuits for a tunnel diode amplifier is another novel form of integrated "antennafier."

In describing the development, Frost emphasized that this is an "integral" amplifier-antenna design, and not merely an amplifier constructed inside the antenna structure. The shape and dimensions imposed on the dipole by its operating frequency are made to serve in a complementary fashion the network requirements of the parametric amplifier, he said.

The parametric amplification mode used is one in which the variable reactive element (diode) is common to three independent loops: it is resonant at the input signal frequency and contains an equivalent source generator at the signal frequency; it is resonant at the output signal frequency including the output load; and it is resonant at the selected higher (idler) frequency.

The structure of a conventional dipole was modified by adding a concentric center conductor. Coupling between the inner region and the outer cylindrical surface occurs because of the fringing capacitance and through the shunt varactor diodes, Frost reported.

The inner region, through its spectrum of TEM resonances, provides the resonant storage regions. The fundamental TEM mode provides the signal frequency, while the fifth order mode was selected for the idler frequency storage.

A resonance at the pump frequency is not required for the parametric gain condition, but it was found that more effective pumping action can be achieved if the pump frequency is matched to the sixth order TEM mode, Frost said.

The output signal is extracted from the coaxial region by a rectangular loop appropriately oriented in a radial plane. The output loop has a length equal to half a wave length of the selected idler frequency, which minimizes coupling as well as resultant loss.

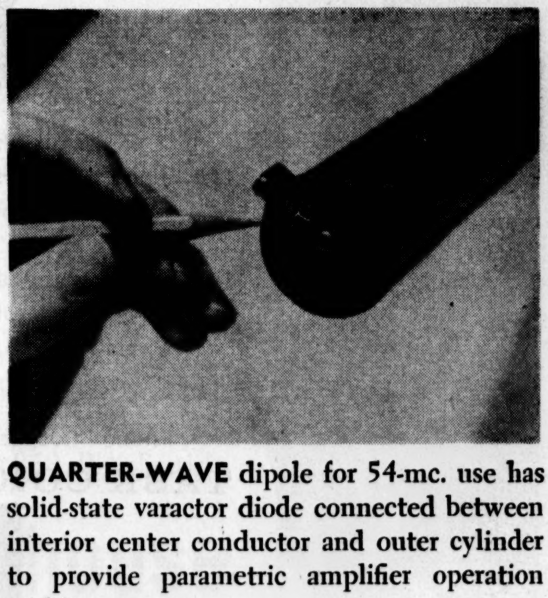
The half-wave parametric amplifier dipole, operating with a pump frequency of 600 mc., produced a gain of as much as 19.7 db. at a signal frequency of 108.5 mc., Frost reported. Gain exceeded 17.5 db. over the signal frequency range of 107.5 mc. to nearly 109 mc., he said.

A change in the reverse (back) bias applied to the varactor diode from the optimum operating value to a point in the forward conduction region can change amplifier gain by more than 45 db., Frost noted. This results from inhibition of parametric amplification action and the combined effect of detuning and resistive shunting of the interior coaxial cavity. This means that a pulse signal control of varactor bias can be used to chop or interrupt an unmodulated signal at a selected rate or to switch the amplifier on/off at will.

Future Effort

Frost said the future work in integral amplifier-antennas might include extension of present dipole configurations to higher frequencies by use of etched circuit techniques to produce the center conductor, output loop and tuning elements as a single integrated assembly. Another possibility is the use of slot apertures as the signal acquisition structure with the required resonant regions located beneath the ground plane.

The new amplifier-antenna can be employed alone or in familiar wave col-



QUARTER-WAVE dipole for 54-mc. use has solid-state varactor diode connected between interior center conductor and outer cylinder to provide parametric amplifier operation within antenna.

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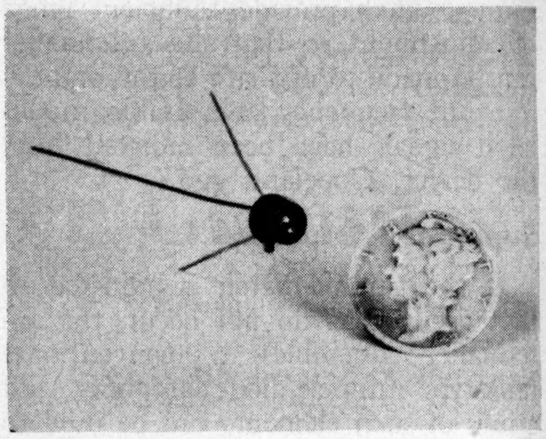
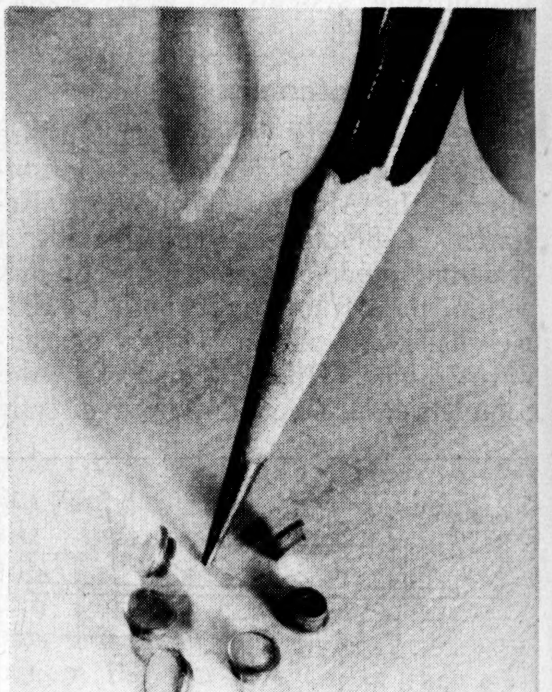
lection/concentration structures, such as Yagi arrays, parabolas and corner reflectors. "Multiple units, provided with in-phase pumping and adjusted for equal gain, offer new opportunities for high-speed scanning of linear or circular arrays, or in direction finding applications using a Wullenweber antenna or Luneberg lens," Frost concluded.

The University of New Hampshire is located at Durham, N. H.; Ohio State University is located in Columbus, Ohio.

NEW AVIONIC PRODUCTS

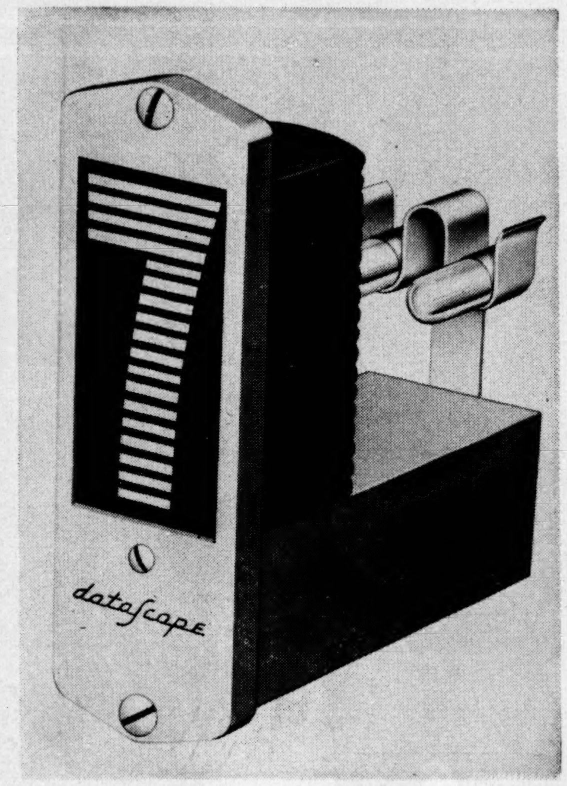


- **Photocell switch,** called "Photran," a light-actuated PNPN silicon switch, has an impedance of more than 10 megohms when dark and less than 10 ohms when illuminated. Device, measuring 0.185 in. dia. x 0.20 in. long, can deliver up to 300 ma. load current at up to 200 v. with efficiency of more than 98%, according to manufacturer: Solid State Products Inc., One Pingree St., Salem, Mass.

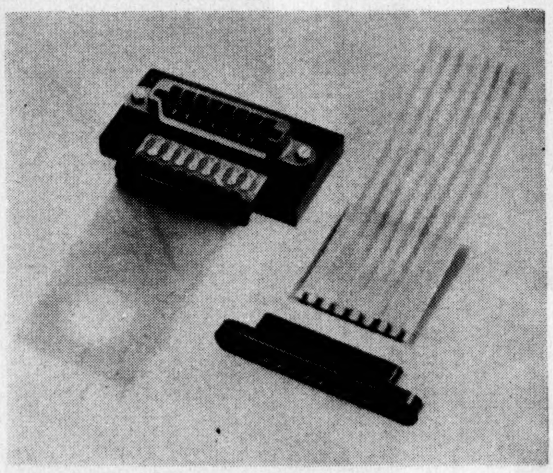


- **Tunnel diode for 10 kmc. operation,** Type D-4168-D, a P-type germanium device capable of oscillating at frequencies above 10,000 mc., has peak currents of approximately 3.5 ma. and minimum peak-to-valley ratio of 5:1. Units with peak current ranges of 4 to

50 ma. also have been developed. Negative resistance is 30-40 ohms, capacity is 1 micro-microfarad and series resistance is 7-10 ohms. Device measures 0.12 in. dia. x 0.057 in. high. Production quantities are available, according to manufacturer: Sylvania Electric Products, Semiconductor Division, Woburn, Mass.



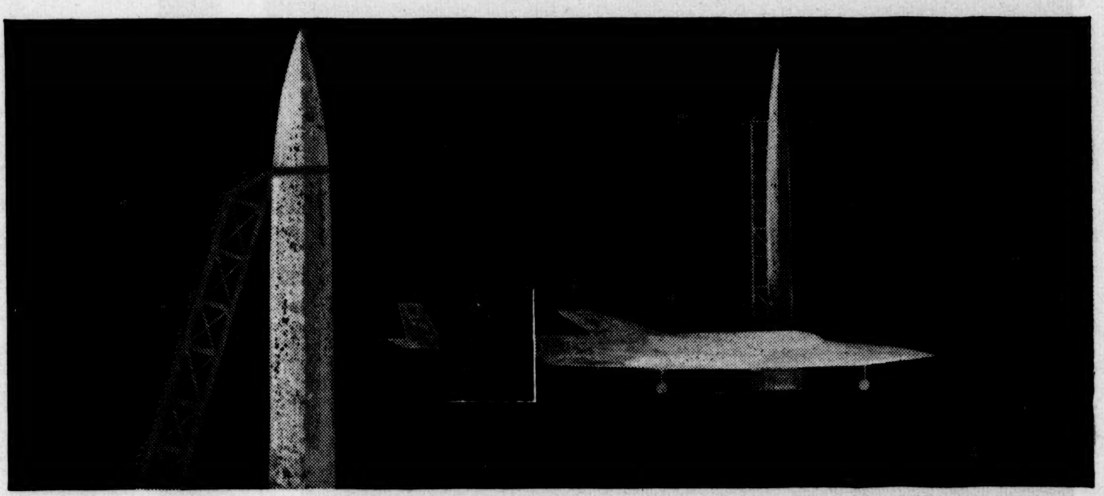
• **Self-decoding digital readout,** occupies only 1.0 x 3.1 in. panel space and extends 2.5 in. behind the panel. Readout accepts either binary inputs or pulse trains and displays information in digital form providing six symbols in addition to 10 digits. Readout can display at rate up to 50 characters per second. Device, which weighs 4 oz., operates from 12 or 28 v.d.c., requires 0.57 watt-second per bit. Manufacturer: Datascope Corp., 4023 Irving Place, Culver City, Calif.



• **Printed circuit connectors,** for operation at temperatures from −60F to 450F, can maintain continuity under sustained 40g vibration from 5 to 2,000 cps., according to manufacturer. Male Fuz-Lok contacts are staked to printed circuit boards or tape cable without soldering. Single and double sided connectors provide from five to 86 individual contacts. Manufacturer: Matrix Science Corp., 3311 Winona Ave., Burbank, Calif.

NEW FROM WESTINGHOUSE:

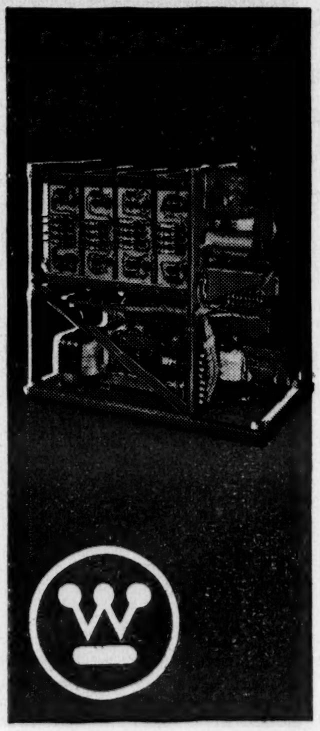
STATIC POWER SUPPLIES FOR GROUND SUPPORT EQUIPMENT

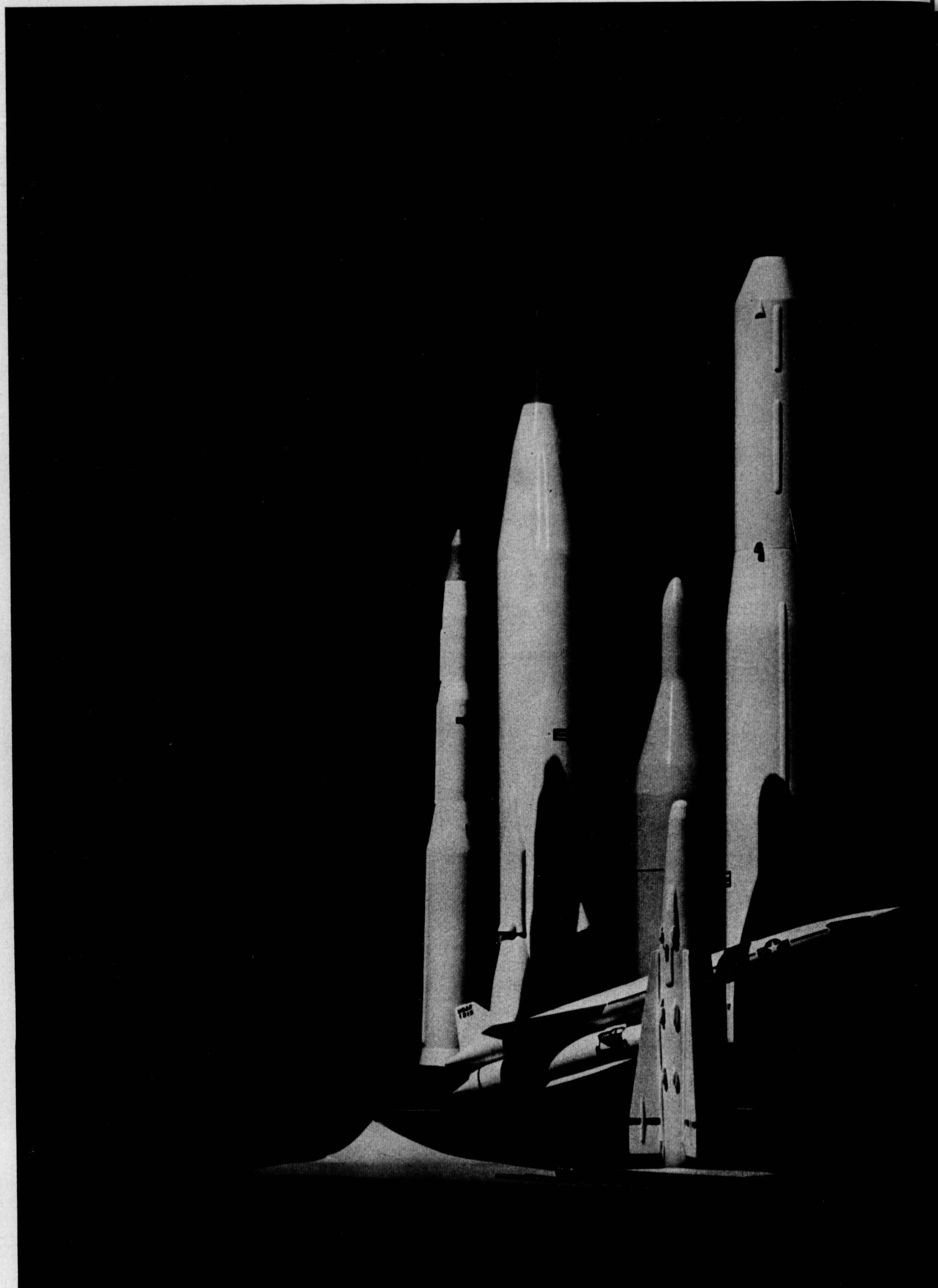


Static inverters and converters in *kilowatts* from Westinghouse convert d-c to a-c, d-c to d-c and a-c to a-c. For ground support equipment applications—from test to launch—these inverters perform unerringly. Operation is completely static. High efficiencies, smaller size and weight, increased reliability, greater packaging flexibility, reduced maintenance are all attainable through use of Westinghouse static inverters and converters. Ratings of 10 kva are obtainable. *Higher ratings are now under development.* A 4.5 kw, d-c to 400 cycle converter is displayed at right. For help in solving your static power supply problems, contact your local Westinghouse sales engineer. Or write: Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania.

J-92504

Westinghouse





Where does Hughes fit in the missile picture?

The modern missile ranks as one of man's most ambitious achievements. To design and build an efficient missile requires a wide range of skills — many of which did not even exist a few years ago.

Today, many firms are pooling their special abilities to speed the development of more effective missiles.

Hughes is active in a number of these team projects, as well as in the production of complete missile systems. Here are some examples of Hughes' current missile work:

POLARIS—Hughes is a prime contractor for the production of complete guidance systems for the Navy's sub-launched ballistic missile and is a subcontractor for the fire control system.

FALCON—With both radar and infrared guidance systems, the Falcon family of missiles has demonstrated amazing accuracy and reliability. To date Hughes has delivered to the U.S. Air Force over 30,000 of these high performance air-to-air missiles. And Hughes recently began production on a new nuclear Falcon missile.

SIDEWINDER—This Navy air-to-air missile will carry Hughes infrared detector and cryostat systems in its most advanced models.

MAULER—A highly mobile anti-aircraft and anti-missile missile now being developed for the Army, the Mauler will have a Hughes designed guidance system.

TITAN—Hughes is manufacturing portions of the launch control systems for this Air Force giant.

Hughes is also under contract to investigate the application of Versatile Automatic Test Equipment (VATE) for the guidance systems on the *MINUTEMAN*, *SKYBOLT*, *ATLAS*, *TITAN* and *HOUND DOG* missiles.

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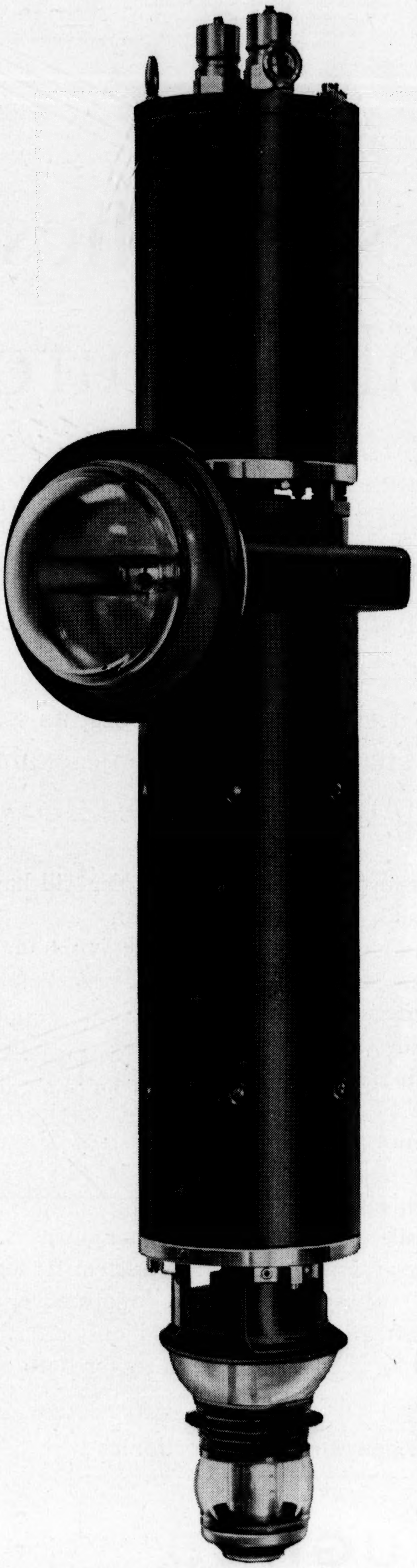

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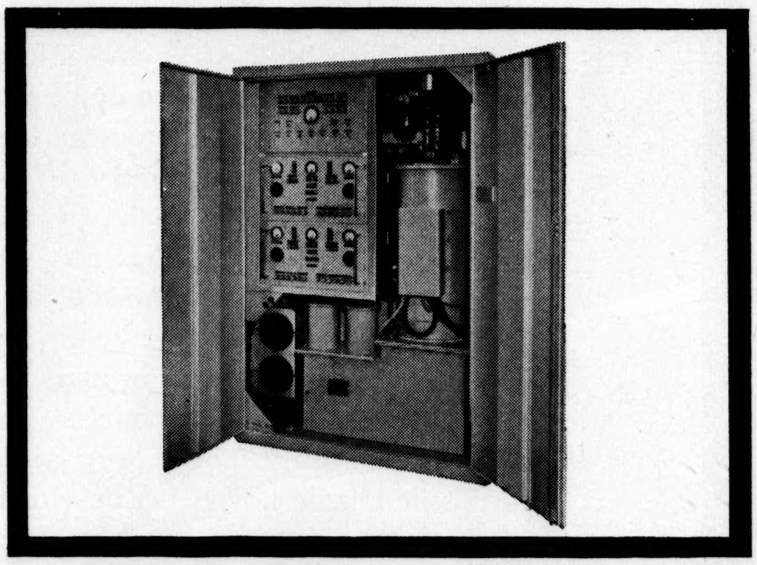
Write to: Litton Industries, Electron Tube Division, San Carlos, California. Or better still, phone: LYtell 1-8411.



Transmitters for the Air Force Search Radar AN/FPS-20, built by Bendix Radio Division of the Bendix Corporation for the Rome Air Development Center, Air Research and Development Command.

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MICROWAVE TUBES AND DISPLAY DEVICES

CAB Accident Investigation Report—Part I:

Structural Failure Cited in Electra Crash

A Braniff Airways Lockheed Electra, Model L-188A, N 9705C, broke up in flight and was further destroyed by ground impact and fire 3.19 miles east-southeast of Buffalo, Texas, on September 29, 1959, about 2309 CST. All occupants, 27 passengers, six crew members and one company employe, were killed.

Flight No. 542 of September 29, scheduled between Houston, Texas, and New York International Airport, with stops at Dallas, Texas, and Washington, D. C., departed the Houston Airport at 2237. The flight reported to San Antonio Center over the Leona VOR at 2305 at an altitude of 15,000 feet. It then made its final radio contact with company radio at 2307.

Structural failure of the aircraft occurred at approximately 2309 while on course to the next fix, Trinidad intersection. Weather at the time and flight altitude was good with scattered clouds above 20,000 feet and with visibility of 10-15 miles. A review of all records and crew reports indicated a routine operation from Houston, except that upon departure a terminal strip on No. 3 propeller was not properly bonded and the No. 3 fuel tank sump pump became inoperative shortly after takeoff.

The probable cause of this accident was structural failure of the left wing resulting from forces generated by undampened propeller whirl mode.

The Flight

Flight 542 departed the ramp at Houston at 2237,[1] 22 minutes behind schedule with a total of 34 persons including a crew of six consisting of Captain Wilson Elza Stone, First Officer Dan Hollowell, Second Officer Roland Longhill, and Stewardesses Alvilyn Harrison, Betty Rusch and Leona Winkler, none of whom survived. The delayed departure was due to a mechanical discrepancy involving No. 3 generator. This generator was inoperative on arrival of N 9705C at Houston. Prior to departure from Houston the Nos. 3 and 4 voltage regulators were interchanged.

Actual gross weight upon departure was calculated at 83,252 pounds, including 17,000 pounds of fuel, and was 16,548 pounds less than the authorized gross weight of 99,800 pounds. The estimated time en route to Dallas was 41 minutes.

The flight was given an instrument-flight-rules clearance which was to the Leona omni, via Victor Airway 13 west to the Gulf Coast intersection, direct to Leona, to maintain 2,300 feet altitude to Gulf Coast, then to climb to and maintain 9,000. At approximately 2240 the flight was cleared for takeoff and at 2242 it reported ready for takeoff and was airborne at 2244.

After takeoff Houston departure control advised that it had the flight in radar contact and requested it to report when established outbound on the 345-degree radial of the Houston omni. Flight 542 complied and subsequently was cleared to 9,000 feet and advised to contact San Antonio Center on 121.1 mcs. upon passing the Gulf Coast intersection.

Flight 542 reported to company radio at 2251 as blocking out of Houston at 37, taking off at 42, to cruise at 15,000 feet when so cleared, estimating Dallas at 2325, and that the Center had this information. At approximately 2252 Flight 542 reported to San Antonio Center as being over Gulf Coast intersection at 9,000 feet. The flight was then issued its destination clearance to the Dallas Airport via direct to Leona, direct to Trinidad, direct to Forney, direct to Dallas, to maintain 15,000 feet. The flight was cleared to climb to its cruising altitude.

The next transmission from Flight 542 was to the San Antonio Center, giving the time over Leona as 05 at 15,000. San Antonio Center acknowledged, and requested Flight 542 to change over and monitor the Fort Worth frequency of 120.8 mcs. at this time. The flight acknowledged.

Shortly thereafter Flight 542 contacted company radio with a message for maintenance, advising that the generators were then OK but that there had been insufficient time for maintenance to insulate the terminal strip on No. 3 propeller at Houston and it would like to have it done in Dallas. At this time the flight also said it would give the communication center a Dallas estimate of 25. This was then followed by one other item for maintenance, which was that No. 3 sump pump was inoperative. This was the final transmission from the flight and was logged as completed at 2307.

Structural failure of the aircraft occurred at approximately 2309 on course to the next fix, Trinidad intersection. The radial from Leona omni to Trinidad intersection is 344 degrees. The main wreckage was located 19.7 miles[2] north of Leona omni, 3.19 miles east-southeast of Buffalo, Texas. The time, 2309, correlates closely with the information obtained from witnesses to the accident as well as the time indicated on impact-stopped watches recovered at the scene.

Investigation disclosed that there were no radar or radio contacts established with Flight 542 nor were any emergency calls received on guard frequencies or en route frequencies after 2307.

Investigation also disclosed that there was no known traffic which could account for a violent evasive maneuver in the immediate vicinity of N 9705C at the time of the accident, nor were there any missiles or unmanned aircraft in the region, according to the Department of Defense.

Surface weather charts for the late evening of September 29, 1959, and early morning hours of September 30, 1959, show a very weak pressure gradient from southwestern Texas east-northeastward to western Alabama. A diffuse quasi-stationary front along the Appalachians reached into central Mississippi and extended along a line running from near Shreveport, Louisiana, to Fort Worth, Texas, thence southwestward to Junction, Texas, and west-southwestward to the Mexican border. The leading edge of this front was some 125 miles to the north of the crash site at the time of the crash.

The route from Houston to Dallas was 60 miles or more east of an area in which U. S. Weather Bureau forecasts called for severe thunderstorm activity. For this route the aviation area forecast, issued at 1852 by the U. S. Weather Bureau at San Antonio, indicated scattered clouds at 4,000 to 5,000 feet and a broken ceiling at 10,000 feet in the vicinity of a few isolated dissipating cumulonimbus mostly over extreme southern Texas, until 2100 and broken to scattered clouds above 10,000 feet elsewhere on the route. Additionally, the forecast indicated that low stratus, scattered to broken at 1,500 feet with its tops at 5,000 feet along the coast, was expected to spread inland and lower to broken to overcast 1,000 to 2,000 feet by 2200 locally 800 to 1,000 feet, overcast; visibility five miles in fog over interior sections after 0200 September 30, 1959.

During the early evening of September 29, 1959, weather reports show that over southeastern Texas there was generally 1/10 to 5/10 of altocumulus clouds at 12,000 feet; 6/10 to 9/10 of cirrus clouds above 20,000 feet; and a few isolated dissipating cumulonimbus with bases around 4,000 feet. A small area of locally heavy thunderstorms, which developed near San Angelo at 1500 and moved east-southeastward, had reached the vicinity of Kerrville and Fredericksburg, Texas, by 2200 decreasing to 10 to 15 miles in diameter and was dissipating in the vicinity of Blanco, Texas, around 2200. At 2200 significant, but isolated, radar echoes were reported southeast of Shreveport, Louisiana, and thunderstorms were visible from Lufkin, Texas.

At the same time, lightning from the thunderstorm area near Blanco was visible from Waco and Austin. College Station, Tyler and Gregg County were clear with visibility 15 miles, while Houston reported only high thin cirrus clouds above 20,000 feet. Dallas had scattered clouds at 12,000 feet in addition to the high thin cirrus deck.

By 2300, surface observations and radar

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[1] All times herein are Central Standard Time based on the 24-hour clock.

[2] All mileages herein are in nautical miles.

reports showed almost all thunderstorms to be dissipating except for an area extending from 25 miles north-northeast to 25 miles north-northwest of Waco. A second area showing on the radar scope at Waco was five miles wide and extended from 30 miles west-southwest of Palestine, Texas, to 30 miles east-southeast of Waco. The latter report places a radar echo approximately eight miles northwest of Buffalo, Texas, and is interpreted as being a rainfall echo, most likely the intermediate and higher level remnants of earlier thunderstorms moving from the west-southwest.

A Grumman Mallard pilot en route from Dallas to Houston later reported encountering intermittent light rain and moderate turbulence at 7,000 feet northwest of Buffalo, Texas, and observed shallow buildups, estimating the tops to be about 10,000 to 12,000 feet. He also reported distant lightning to the west of course. This pilot reported that no weather was encountered south of the Leona intersection, which is about 23 miles south and slightly west of the accident site. The pilot of a military C-47 flying from Shreveport to Houston some 80 or more miles east of the accident site reported in smooth air at 6,500 feet and that the weather was clear between the C-47 and what was later determined to be the burning airliner.

According to ground witnesses in Buffalo, Texas, and the immediate area at the time of the accident, skies were partly cloudy, the visibility was good, and no lightning was observed. Shortly after the accident a few light showers were observed in the Buffalo area, but not at the accident site. By midnight the only thunderstorm in the area was located by surface and radar observation within 30 miles of and northwest of Waco.

While the flight crew of Braniff Flight No. 542 did not receive a preflight weather briefing at the Houston office of the U.S. Weather Bureau, company meteorologists provided the flight with current and forecast weather information for the route and terminals concerned.

Witnesses

All passengers aboard the aircraft when it arrived at Dallas from Chicago as trip 61/29 who could be contacted by telephone were later questioned. No unusual incidents which could be directly related to this accident were revealed.

Every known witness who either heard the aircraft at the time of difficulty or observed the fire in the sky was interrogated. Statements were obtained from all who were considered able to contribute to the investigation.

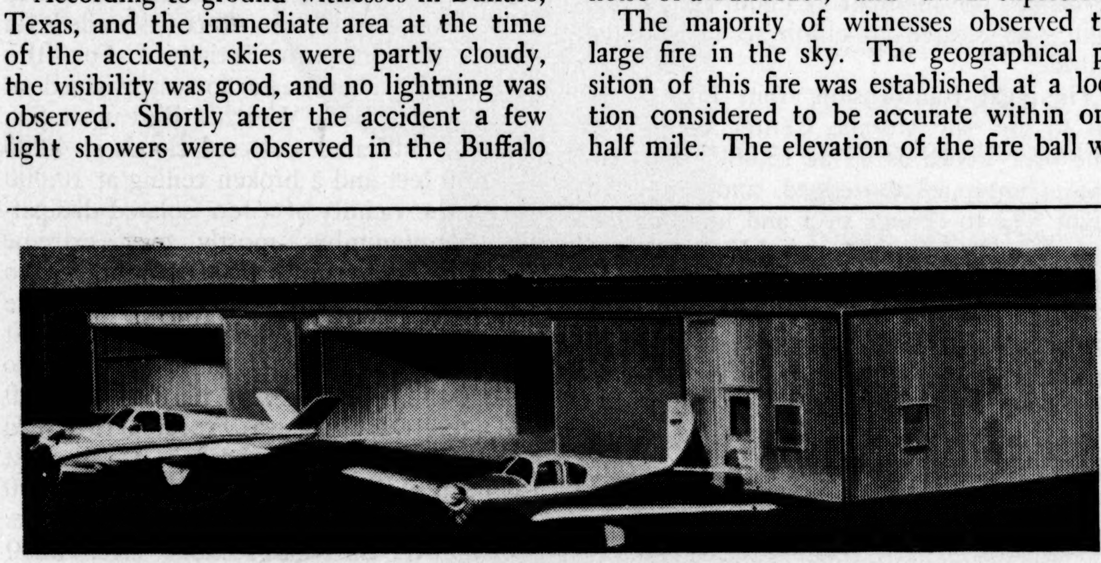
Witnesses reported hearing various noises of different intensities and of different pitches. Many of the sounds were likened to known noises such as the "clapping of two boards together, the sound of thunder, the roar of a jet plane breaking the sound barrier, whoosing screaming noise, creaking noise of a bulldozer," and "awful explosion."

The majority of witnesses observed the large fire in the sky. The geographical position of this fire was established at a location considered to be accurate within one-half mile. The elevation of the fire ball was calculated from information provided by three witnesses who were judged the best source for this information. Each had a fixed reference point for establishing the angle of elevation. This effort resulted in a minimum altitude of 17,000 feet and a maximum of 23,000 feet.

One witness stated that he observed a white light prior to hearing the unusually loud noise from the aircraft or observing the fire ball.

Following this accident, 12 known unusual noises such as jet aircraft, sonic booms, propellers at supersonic speeds, Electras cruising normally, and intentionally random noises were put on tape. This tape was played back to witnesses individually in an attempt to identify more closely the noise associated with the accident. None of the witnesses had been apprised of the source of the sounds they were about to hear. The net result of this effort was to liken the noises to those of propellers at supersonic speeds and/or those of jet aircraft.

The wreckage was distributed within a long, narrow ellipse, the major axis of which was approximately coincident with the 344-degree radial of the Leona omni. The first item found at the southern edge of the wreckage pattern was a nine-inch section of hydraulic line from the left heat exchanger, and its position was fixed as 17.4 miles north of the Leona station. Proceeding northerly from this point toward the main wreckage, the major components were located in this order: No. 1 propeller and gearbox; left wing (including No. 1 engine and the No. 2 powerplant); No. 4 powerplant; left out-



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board stabilizer section; right outboard wing panel; followed by the main wreckage area consisting of fuselage, empennage; No. 3 powerplant, and right wing stub.

The wreckage was strewn for a total distance of 13,900 feet from the first recovered item to the nose crater, with some lateral spread of the debris, due in part to wind effect. the lighter pieces being generally east of the more dense ones. Two parts of high density, and therefore subjected to only slight trajectory deviation, were the No. 1 propeller and gearbox package and the No. 4 powerplant. The direction between these was 341 degrees, magnetic.

At the main area, 3.19 miles from the highway intersection in Buffalo and on a bearing of 92.75 degrees from that intersection, there were three basic concentrations of wreckage, one around the nose crater, one at the center section crater, and one at the tail cone. In addition, there was a wide scatter of aircraft parts and debris. Light material, such as paper, plastic, and insulation was found as far away as a half-mile to the north and northeast.

The material at and west of the nose crater was, without exception, identified as fuselage and fuselage-contained components from the nose to fuselage station 570. This debris covered an area of about 20,000 square feet of open, plowed ground. The nose crater, about four feet deep, was at the easternmost end of the area, and the fuselage material was fanned out westward for a distance of 200 feet. Approximately 90% of the forward fuselage was in crushed sections of two feet square or less.

The second concentration was approximately 200 feet northeast of the nose crater and in a heavy growth of scrub oak. The material in this vicinity consisted of the center section, right wing fragments, the No. 3 powerplant, rear cabin structure, and components related to these portions of the airframe. The direction of travel here at the time of impact was 320-340 degrees as indicated by tree breaks and ground furrows.

The tail section was located 250 feet northwest of the center section, with the rudder and elevator control cables lying across the tops of the intervening trees.

The trees between the three areas were undisturbed except at localized points where loose objects had passed through the branches.

Systems

The cockpit of the aircraft was almost totally demolished. Those portions which were recovered were found at the bottom of the crater made by the nose of the aircraft. These were damaged so extensively that few of them were even recognizable. Nevertheless, great effort was put into studying this debris, including the remnants of flight and powerplant instruments, but this study yielded no information significant in establishing the cause of the accident.

The recovered flight engineer's log sheet for 2250 showed that the altitude at that time was 7,000 feet; indicated airspeed 210 knots; indicated outside air temperature 27C; engine and airfoil anti-icing off; and engine instruments indications were normal. The flight engineer's log sheet for 2300, which was recovered, indicated altitude 15,000 feet; indicated airspeed 275 knots; indicated outside air temperature 15C. The

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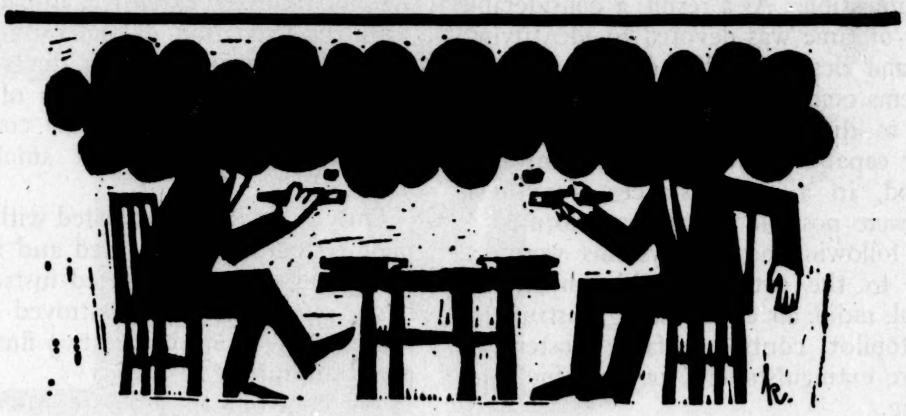

In the game of "Stogey," two players alternately place cigars on a rectangular table with the restriction that each new cigar must not touch any of the previously placed cigars. Can the 1st player assure himself of victory if we define the loser as the first player who finds himself without sufficient room to place a cigar?

– Contributed

Designed to improve training and manufacturing techniques in the production of complex electronic sub-assemblies, compact audio-visual equipment is available from the Applied Communication Systems of Litton Systems, Inc. In an application, an ACS System increased production by 40%, reduced rejects by 90%.

ANSWER TO LAST WEEK'S PROBLEM: Only one man, Methuselah, who attained the record age of 969 years. Solving the equation $2^{3217} = 10^x$, we have $x = 3217 \log 2 = 968.4$. The number of digits in $2^{3217} - 1$ is one more than the integral part of x or 969.

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First Takeoff of Federal Aviation Agency Boeing 720

Boeing 720 built for the Federal Aviation Agency, powered by four Pratt & Whitney C-7 turbojets, is shown taking off for the first time from Renton Municipal Airport, Wash. FAA will use the aircraft in connection with its training program for safety inspectors.

engine and airfoil anti-icing systems were off; engine instrument indications appeared normal. None of these readings indicate any abnormality.

Damage to the airframe had been so great that no aircraft system, as such, survived. In addition, impact and fire had destroyed or damaged individual systems components to the extent that functional checks were generally impossible. As a result, a considerable amount of time was devoted to identifying, listing and describing the damage received by systems components. It was deemed advisable to disassemble certain components thought capable of yielding useful information and, in a few instances, functional checks were possible and were performed.

The following aircraft systems were examined to the extent possible: hydraulic, electrical, radio, air conditioning, instrument and autopilot, control surface booster, air start, fire extinguishment, oxygen, fuel and anti-icing.

No indication of operational distress was found through examination of the hydraulic and electrical system components. The left inboard main landing wheel had been involved in considerable fire and it was dismantled to permit inspection of the brake assembly. No abnormal heat patterns were noted such as might be expected from excessive braking action.

No evidence of fire or overheating was noted during inspection of the recovered radio components, all of which had suffered extensive impact damage. Examination of transmitters and receivers revealed the following estimated settings:

- **No. 1 VHF Transmitter**—130.5 mc.
- **No. 2 VHF Transmitter**—120.7 or 120.8 mc.
- **No. 1 VHF Communications Receiver**—130.5 mc.
- **No. 2 VHF Communications Receiver**—120.7 mc.
- **No. 1 VHF Navigation Receiver**—110 + mc. (tenths could not be determined).
- **No. 2 VHF Navigation Receiver**—110.8 or 112.8 mc.
- **No. 2 Omni Bearing Indicator**—166 degrees.
- **No. 1 ADF Receiver**—365 kc.
- **No. 2 ADF Receiver**—540 kc.

All recovered items of the air conditioning system received extensive impact damage with the exception of the outflow control valve. The majority of air ducts had been destroyed; however, inspection of recovered duct sections and the outflow control valve disclosed no indication of smoke or fire damage.

Only three items associated with the autopilot system were recovered and these were badly crushed. All recovered instrument system components were destroyed by impact with the exception of the two fluxgate compass transmitters.

The control surface booster assemblies had suffered moderate impact damage, which prevented their being tested as complete assemblies. However, individual components capable of operation were given functional tests and those which could not be tested were dismantled and examined in detail. All discrepancies noted were attributed to crash impact damage with the exception of a failed electrical lead at the load sensor of the elevator booster assembly.

The load sensor was subsequently examined by the National Bureau of Standards whose report states, in part, "The break in the stranded wire in the sensor unit was probably caused by several cycles of reversed bending, rather than by a single tensile or bending load."

The left air compressor assembly of the air start system was recovered at the left wing impact site. The compressor had been consumed by fire; only an ash residue remained which readily broke and flaked away when the assembly was removed for shipment. The right compressor assembly was demolished by impact but showed no evidence of fire. Both of the right air bottles remained intact in the No. 4 nacelle and still retained an air charge of unknown amount, which was released as a safety measure before removal of the wreckage. Both of the left air bottles were also recovered. One was found separated from the wing structure at the impact site. It was slightly dented and the air lines had been torn off at the flanges. There was no evidence of fire. The second bottle was still in position in No. 1 nacelle.

The fire bottles of the No. 3 nacelle had not been discharged electrically but they had been broken by impact forces and contained no extinguishing agent. The bottles from the No. 2 nacelle had been involved in fire and both discharged heads had been fired. These were examined by the manufacturer who concluded that the outboard unit probably was discharged as a result of thermal discharge of the actuating cartridge and that the inboard unit was discharged through the safety disc by excessive pressure resulting from the fire, the actuating cartridge being subsequently discharged by action of the fire. Both rotary selector valves of the extinguishing systems were recovered and their internal porting was determined to have been normal.

Two oxygen bottles (1800 psi.) were recovered minus their regulator caps, which had been broken off. One crew bottle (39.4 cu. ft.) was recovered only slightly damaged and with its valve in the open position. The flight engineer's oxygen panel was found badly crushed. The oxygen mask was still attached to the regulator. No body tissue was found in or around this mask. Five additional masks were recovered in a torn condition with face glasses missing; none of these had evidence of human tissue on their inner surfaces.

The four fueling valves were functionally

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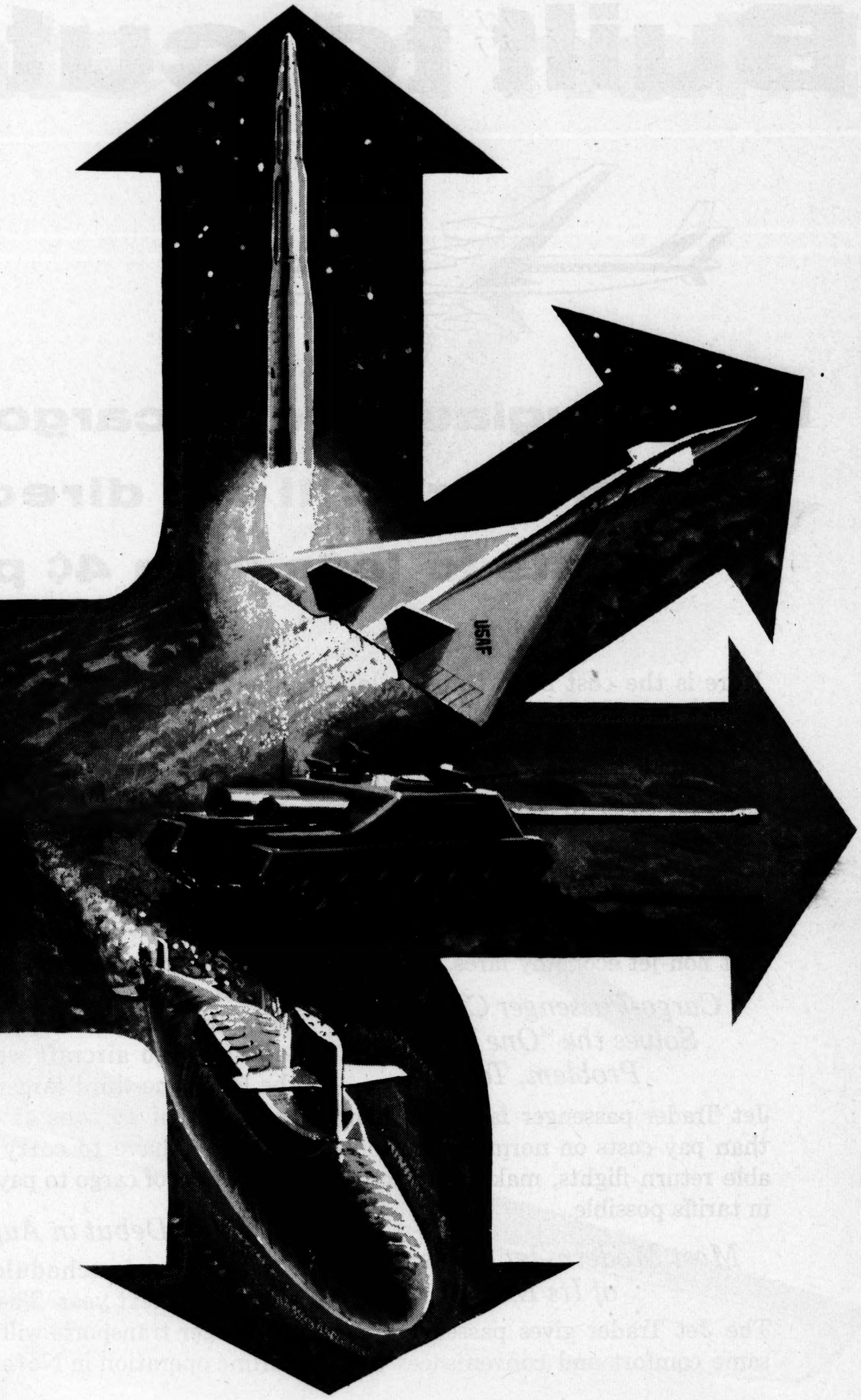

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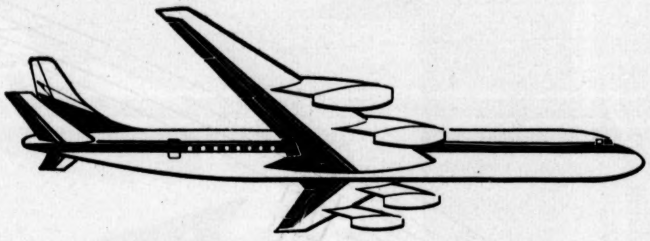

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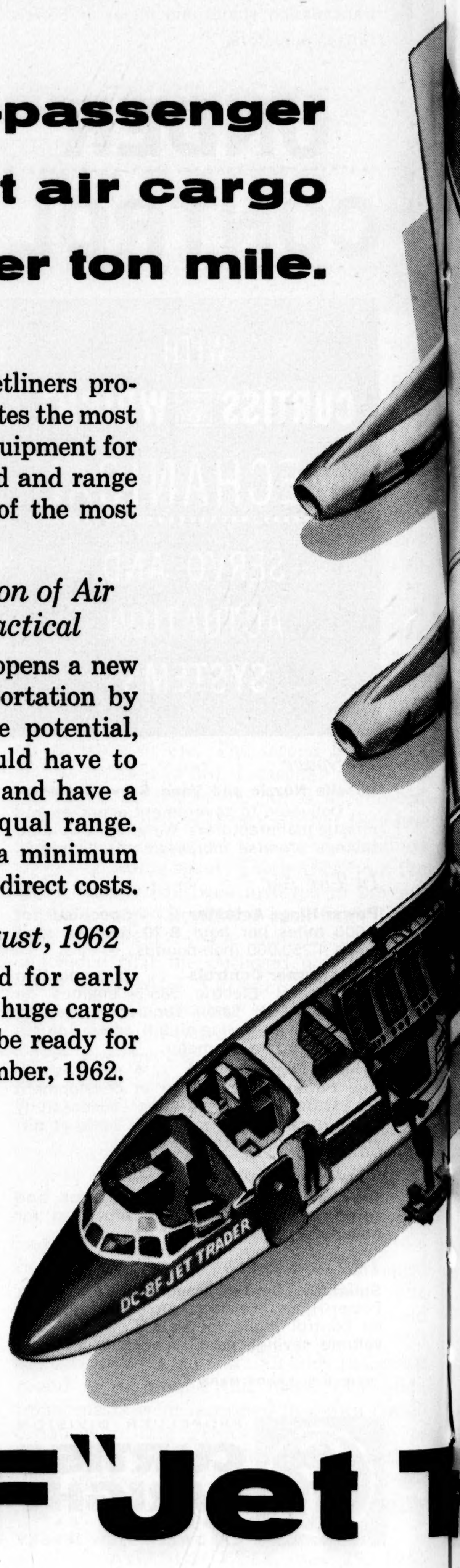

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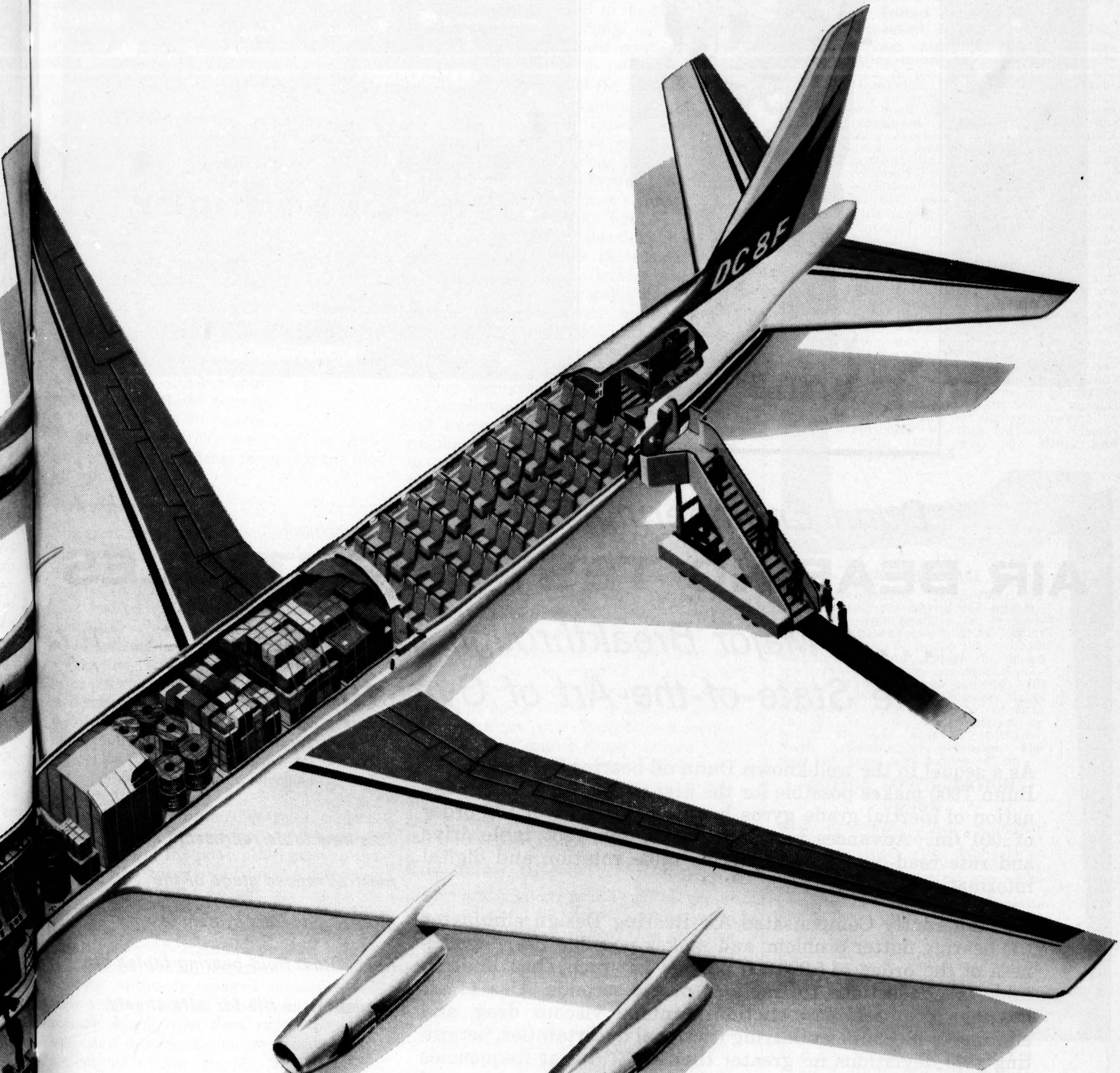

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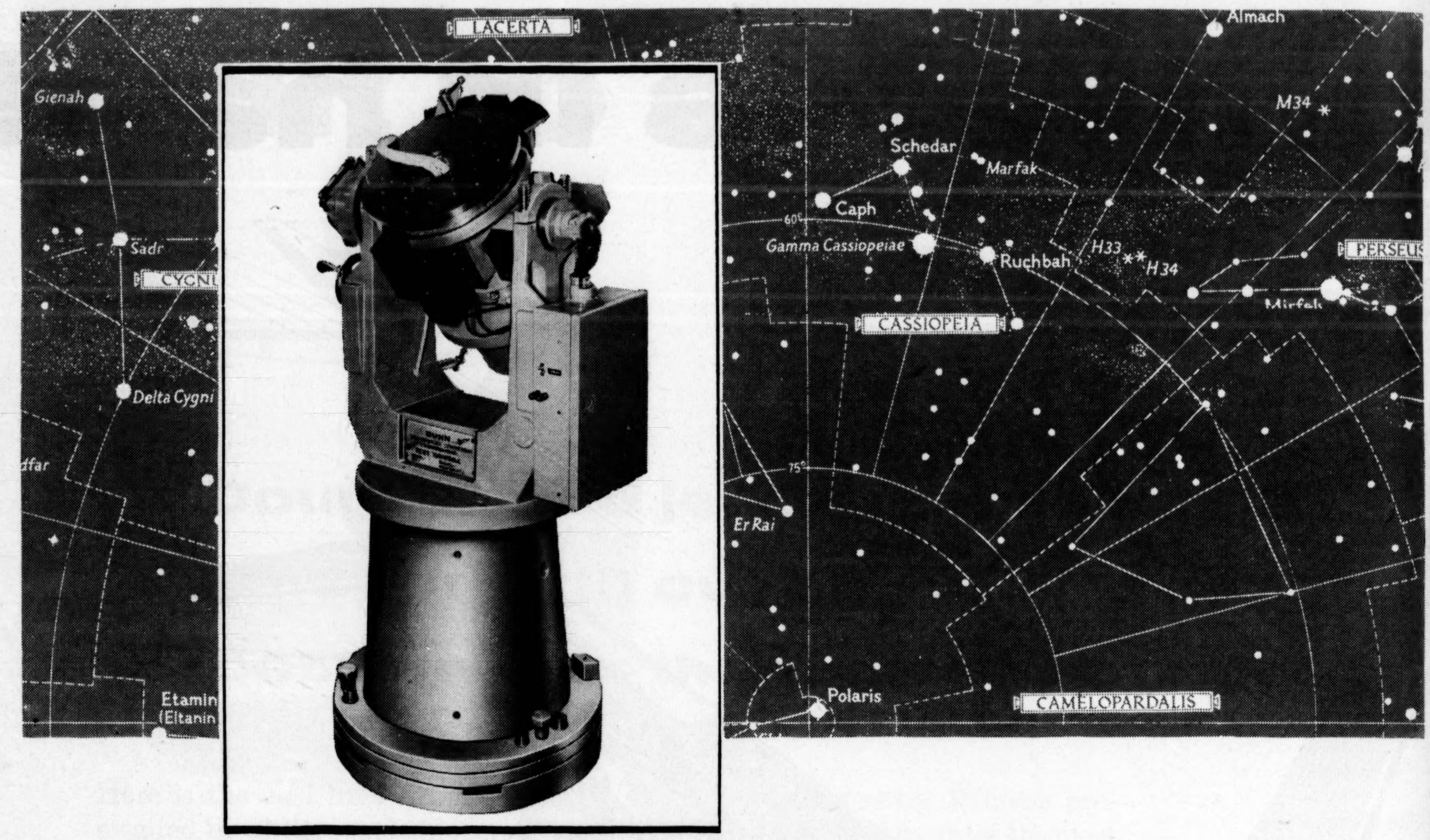
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checked and then dismantled and inspected. Each valve required replacement of its impact damaged solenoid, after which its mechanical functioning was found to be within operating limits. Inspection disclosed no defects or abnormal wear. No significant contaminants were found within the valves.

The pilot valves from tanks 1, 2, and 4 were recovered. Only the No. 4 valve could be tested and it functioned normally. No signs of pre-existing abnormalities were noted during examination of these valves.

The fuel dump valves were impact damaged but were in the closed position. One tank shutoff was found in the closed position and one emergency shutoff valve was found in a partially closed position but was free to move. Three electrically operated shutoff valves were found minus their motors. One was closed and two were open.

The fuel gauges of the fueling panel were examined by the manufacturer who determined their final indications by two separate techniques, one of which involved gear measurements. The results of this method are considered to have an estimated accuracy of ±62 pounds and were as follows:

- **No. 1 tank**—3,960 pounds.
- **No. 2 tank**—3,610 pounds.
- **No. 3 tank**—4,080 pounds.
- **No. 4 tank**—4,080 pounds.

Insufficient recovery was made of anti-icing system components to provide any useful information.

Powerplants

A great amount of the powerplant investigative effort was directed toward determining if a failure or malfunction of any of the engines, propellers, or their associated systems had contributed to or caused the accident. Activity covered the following areas:

- **Oil systems for significant** contamination.
- **Propeller reduction gear** and accessory drive systems for gear and/or bearing failures.
- **Torquemeters for rotational** interference.
- **Power section rotors** for over-temperature indications, bearing failures or rotor failures.
- **Fuel pumps and fuel controls** for failures.
- **Propeller pitch change mechanisms** and controls for failure.

Detailed examinations in these respects did not reveal any evidence of failure or malfunction of the powerplants prior to the start of the separation of the No. 1 engine power section at the air inlet housing to the compressor split line.

The investigation of the powerplants as well as other investigations revealed specific items which warrant discussion.

Some witnesses reported hearing noises (this subject will be detailed later in this report), which from their various locations suggested possible engine overspeeding. Examinations of the engines and propellers were made in detail for overspeed evidence of the kind that were noted during development tests. The first evidence of overspeed from tests, perceptible turbine and compressor tip diameter growth and resultant compressor tip rub, occurs at 20% overspeed (16,600 engine rpm.).

At increasingly higher overspeeds, compressor tip rub is more pronounced, turbine blade tip rub and some bearing distress becomes evident. No measureable growth of turbine or compressor diameters or bearing distress of the kind associated with overspeed was noted. Based on propeller development work, the first evidence would be brinelling of the blade bearing races and it would occur at about 53% (21,120 engine rpm.) overspeed. Forty-one percent (19,500 rpm.) overspeed tests showed no brinelling. No brinelling of the kind that would result from overspeeding was noted on any of the propeller bearing races.

Attention was directed to the No. 3 powerplant by unusual markings on the safety coupling, the 50% closed position of the electrically operated oil shutoff valve and the totally closed position of the actuator of the electrically operated fuel shutoff valve located within the fuel control. These shutoff valves are operated by the cockpit powerplant emergency control which among other functions feathers the propeller. Operating time from "open" to "closed" of these valves are; fuel, .3 to .4 seconds and oil, .5 to .97 seconds.

The safety coupling functions to disconnect the propeller from the engine in the event other protective devices have failed to function and the propeller is furnishing energy (negative torque) by windmilling action to drive the engine. This action by the safety coupling is generally termed "decoupling" and occurs when negative torque reaches approximately 1,700 shp.

Comparison of the marks on the inner and intermediate members of the No. 3 coupling with like marks on couplings known to have operationally decoupled and ratcheted revealed a dissimilar pattern. Metallographic and visual study revealed that high negative torque loads were applied while the intermediate member was out of alignment with the outer member. Impact loads between the inner and intermediate members were applied in both the positive torque and axial direction.

Separation of the No. 1 engine at the air inlet to compressor case split line occurred early in the sequence of events as evidenced by the parts forward of the separation line being the first major component along the flight path. Except for a section of the air inlet casting flange between 5:00 and 7:30 o'clock location which broke away and remained with the compressor flange, the $\frac{1}{4}$-28 cap screws separated by tension failures and the $\frac{5}{16}$-24 cap screws pulled the inserts from the air inlet castings.

Cap Screw Inserts

Cap screw inserts which pulled out at the 10:00 to 11:00 o'clock location wiped metal from the face flange. The direction of this wiping action indicates the inlet housing rotated with respect to the compressor about a point measured radially outward at 11:00 o'clock and five to six inches outside of the bolt circle. Direction of rotation was clockwise relative to the compressor case and looking forward. The air inlet housing flange showed compressive loading between the 10:00 to 11:00 o'clock location. A visual and metallographic examination indicated that most of the scrape marks at the holes where the bushings pulled out had been made by the external threads of the bushings and there was no evidence found of a reversal of the scraping direction or repetitive movement of the bushings across the scraped areas. Hardness tests of the stud and case materials were satisfactory.

Marks were made by contact of the leading edge of the first stage compressor blades

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with the surface of the shelf just rearward of the inlet guide vanes. Rubs were confined primarily to the areas between 3 degrees and 90 degrees and between 176 degrees and 230 degrees, starting from the top and progressing clockwise. The rub marks were not truly circumferential in that those between 3 degrees to 90 degrees angled forward about 6 degrees and those between 176 degrees and 230 degrees angled rearward about 3 degrees. The directions are referenced to the counterclockwise rotation of the compressor rotor.

The internal spline on the compressor stub shaft and the male spline of the compressor extension shaft showed contact marks on their normally loaded sides. The contact marks were made during the final $\frac{1}{8}$-inch mesh of the splines as separation occurred.

No. 1 propeller blade angle when recovered was in the order of 51 degrees to 56 degrees. The remaining propellers were at or near feathered.

Structures

A major portion of the aircraft structure was shipped to a Dallas warehouse for further study. All structure was examined for break patterns, fire damage, stress patterns, explosive damage, and mechanical defects, with many of the individual pieces and/or sections being subjected to laboratory examination and evaluation. Certain sections of the structure were assembled in mockup form to help define failure, breakup and fire patterns. All of the structural damage was classed as from one or more of the following: airborne disintegration, ground impact, airborne fire, and/or ground fire. After a basic study of wreckage distribution, it became evident that the aircraft had experienced airborne disintegration which broke the aircraft up into a number of major sections as outlined under "Wreckage Distribution."

The left wing struck the ground butt-end first, right side up, after passing through trees approximately 50 to 70 feet high. Included with the left wing were the left landing gear, No. 2 QEC[8] unit and the No. 1 engine (minus propeller, gear box, air inlet housing, and QEC structure). The wing was subjected to intense ground fire as a result of the ignition of fuel from the No. 1 fuel tank.

The ground fire area extended 150 to 200 feet ahead of and approximately 100 feet behind the wing, but laterally only a few feet beyond the tip and the root. Some portions of the left wing in the trees showed no evidence of fire, whereas others directly over the principal wing wreckage showed light deposits of smoke. The starter compressor (magnesium), located normally in the rear of No. 2 nacelle area, was completely consumed by fire and its louvered cover panel lying under it showed signs of heavy black smoke exiting through the louvers: however, the adjacent cover panel was found outside of the ground fire area and showed no evidence of ever having been subjected to fire or heat.

The initial left wing separation occurred between the No. 2 nacelle and the center section. During the mockup of this area, approximately 80 per cent of the lower planking in the No. 2 fuel tank area was ac-

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[8] QEC is used herein for "Quick Engine Change."

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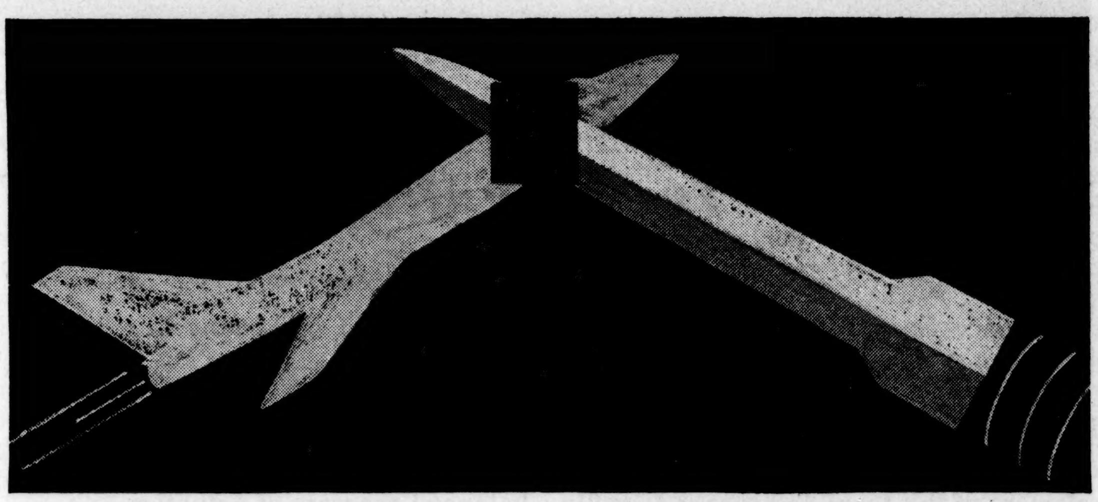

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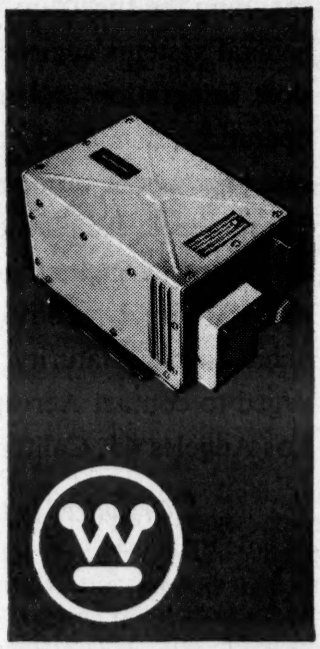

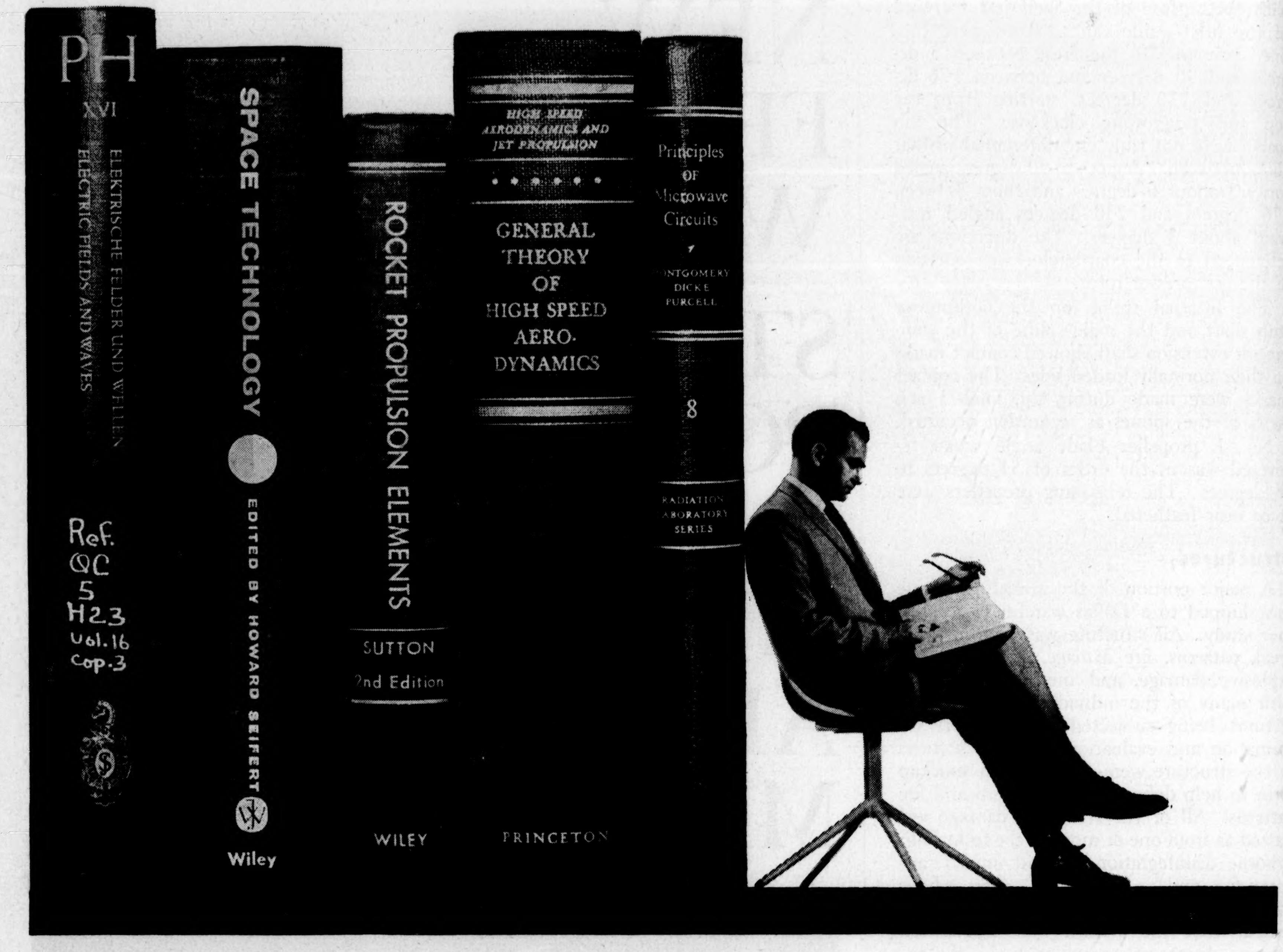
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counted for and fitted into place. The upper planking of this area, in contrast to the lower planking, had been shattered into many small fragments. This made it difficult and in many cases impossible to fix the exact location for each piece; some pieces could only be fitted into a general wing station area.

Only a limited number of front spar pieces could be identified; however, the separation point was identified by fitting together two mating pieces of top cap, the inboard of which had been found at the main wreckage site and the outboard of which was dug out of the ground at the left wing site. This point was eight inches outboard of wing station No. 83. Most of the rear wing spar section from station No. 65 to station 137 was recovered except for minor fragments. That portion of the rear spar inboard of wing station No. 97 remained with the center section, while the outboard section from this wing station fell with the wing.

The lower planking inboard of wing station No. 137 showed evidence of upward bending with the bending being slight in the area of the No. 1 plank and being progressively more pronounced toward planks Nos. 8 and 9.

The lower planking stiffeners were severely column-buckled at every bay from plank No. 1 to No. 9. The rear plank was "S" shaped, being horizontal from wing station No. 65 to approximately wing station No. 75, curling sharply upward through wing station No. 85, and turning down to horizontal at approximately wing station No. 90.

The upper planking pieces in the No. 2 tank area were, in general, jaggedly rectangular with the long dimension spanwise. Only a few pieces of planking bridged a rib cap, and those which did usually contained a plank lap joint. Upper plank No. 9 from wing station No. 75 to wing station No. 101 showed the same "S" shape as did the lower plank but to a less pronounced degree. In contrast with the lower planking the stiffeners of the upper planks had separated along or very close to the radii.

The fracture faces of lower wing plank No. 3 at wing station No. 65 left, showed evidence of having recontacted each other after the fracture occurred. Microscopic examination disclosed at least three cycles of recontact. Two of these were evidenced by contact scratches; the third by a zinc chromate deposit.

Wing Station

The wing station No. 83 closing rib of the left leading edge contained metal-to-metal scratches at nine points. These marks were predominantly vertical, but microscopic examination showed three to four changes of direction at three different points.

Substantially the entire section of the left wing that fell separate from the aircraft showed evidence of varying fire damage. The fire pattern on the upper and lower planking of the No. 2 fuel tank was of a random configuration such that one piece or section would exhibit severe exposure to fire or heat whereas its mating piece would not. The zinc chromate in section of the flaps aft of and inboard of the No. 2 nacelle and in sections of the fillet area between wing and fuselage had been browned by exposure to heat; however, the patterns once again were random and showed lack of continuity. This same general fire pattern was evident on pieces of wing leading edge. The left wing flap jack screws were found in the fully retracted position.

Local Service Passengers 1959-1960

	Average No. Psgrs. Per Aircraft 1960	Average No. Psgrs. Per Aircraft 1959	Change Per Cent	Average No. Seats Per Aircraft 1960	Average No. Seats Per Aircraft 1959	Change Per Cent
LOCAL SERVICE						
Allegheny	15.4	14.5	6.3	36.3	30.8	17.9
Bonanza	13.9	12.5	11.8	35	27.8	26.2
Central	8.1	7.7	5.3	21	21	...
Frontier	9.5	8.7	9.4	24.8	22.8	8.5
Lake Central	9.7	10.4	−6.9	25.3	25.4	−.3
Mohawk	18.6	19.2	−3.3	41	35.2	16.7
North Central	11.7	11.6	1.4	27.2	26.4	3.1
Ozark	10.9	10.8	1.1	27.1	25	8.4
Pacific	16.9	17.1	−1.5	34.2	32.1	6.5
Piedmont	13.3	12.6	5.2	29.6	28.2	4.9
Southern	8.2	9.4	−12.6	26	25.9	.4
Trans-Texas	8.8	9	−2.5	23	23	...
West Coast	13.6	13.5	.9	30.6	30	1.8
Total Local Service	12.2	12	2.1	29.2	27	8.1
HELICOPTER						
Chicago Helicopter	5.7	6.1	−5.7	11.9	12	−.3
Los Angeles	2.7	2.8	−2.3	4.9	5	−1.3
New York	6.9	6.3	9.4	13	12.9	.5
Total Helicopter	5.2	5	3.8	10.3	9.8	5.4

In the No. 3 fuel tank area of the right wing the lower planking was shattered into narrow spanwise strips. There was more deformation present than there was in the No. 2 tank area, particularly the stiffeners which were torn away from the planking and bent in random directions. There was some evidence of column-buckling of the stiffeners on the No. 1 to No. 4 planks, but much less severe than in the left wing.

The separation of the right wing occurred between wing station No. 329 and wing station No. 346. The lower No. 3 plank inboard of wing station No. 346 showed a shear buckle pattern from wing station No. 329 to wing station No. 346. The upper surface panels were bent slightly upward in the area of the break and the broken ends of the stiffeners were pulled rearward. The right wing showed no evidence of having been exposed to heat, smoke, soot or flame impingement.

The propeller, engine gear case, air inlet housing, and the quick engine change structure of the No. 1 powerplant separated as a unit as a result of failure of nacelle and/or QEC longerons at the QEC-nacelle fittings. The engine unit aft of the compressor front face remained in the No. 1 nacelle and descended with the left wing.

The forward attach point of the No. 1 QEC upper outboard longeron showed heavy compression loading prior to failure and further disclosed multiple directions of local bending in the several longeron members.

The forward attach area of the No. 1 QEC upper inboard longeron showed a tension failure followed by recontact of the fracture faces during a would-be compression load. The electrical connectors and their wiring at the No. 1 nacelle firewall were failed in multiple directions of bending.

At the No. 1 nacelle firewall, the fuel line was bent up/inboard and down/outboard prior to the ultimate failure which was up/outboard.

Indentations were found in the nacelle shroud which were made by the anti-swirl assembly clamp, particularly in the area of the clamp bolts. There were indications here of not less than seven contacts of the bosses with the nacelle. There were also multiple clamp marks around the shroud but less pronounced than those at the clamp split-line.

All panels and structure of the No. 2 QEC and nacelle were accounted for and included the landing gear door and starter compressor section. This entire section with the exception of the outboard starter compressor housing showed evidence of having been subjected to fire and heat exposure. A considerable amount of molten aluminum deposits was found throughout the nacelle area; however, none of the deposits showed evidence of having been blown by an airstream.

Fire Exposure

The No. 3 QEC and nacelle were both completely demolished by ground impact. All examined pieces of this area revealed no evidence of having been exposed to fire or heat nor was there any evidence of smoke or soot deposits in this area.

The No. 4 nacelle barrel outboard panel was peeled directly outboard and aft, and rivets in the lower forward corner of the inboard barrel side panel were sheared in a forward direction. All firewall fittings were bent outboard and cables notched. the firewall in an outboard direction. Only those portions of the structure which were carried to the ground with the engine showed any indications of exposure to fire or heat.

The forward fuselage section from the nose through approximately fuselage station No. 570 was subjected to severe impact forces when it struck the ground and for the most part was reduced to crushed rubble. A thorough examination of the recovered

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and identifiable parts from this area showed no evidence of heat, fire, or soot.

The rear fuselage, the center section, including the right wing-to-wing station No. 329, and the rear portion of No. 3 engine struck the ground with great force. The rear half of the lower center section planking remained intact. The rest of the center section box area was reduced to hand-sized fragments. The planking and front spar of the right wing stub were shattered with only the lower planking material remaining in large sections. The fuselage side and top panels were distributed over a wide area but the individual panels were relatively free of severe impact marks and crushing effect. There was no evidence of fire or soot on the right side of the fuselage, in the center section, right wing stub, or the interior of the fuselage.

The exterior surfaces of the left fuselage panels revealed considerable evidence of inflight fire effects. The biaxially stretched plexiglass cabin windows on the left side aft of fuselage station No. 659 had been surface distorted in the form of intersecting trenches and variable sized rectangular raised areas or islands. The severity of the window distortion increased progressively toward the aft end of the fuselage. This type of surface distortion is a common characteristic of this plastic when it is exposed to above normal heating effects either by direct flame impingement or by radiated heat. The exposure time, type of heat and applied temperature are all variables which will cause distortion pattern changes, i.e., depth of trenching, size of islands, and degree of edge roughness.

Lockheed Aircraft Corporation conducted tests to attempt to determine the nature of controlled variables which would cause similar type of distortion of plexiglass samples as evidenced by the fuselage windows. Reasonable correlation between laboratory tests and observed heat effects on the airplane was achieved in several instances; however, it is noted that the controlled test condition did not necessarily represent the existing airborne conditions at the time of occurrence. The following is a quoted summary of Lockheed's Report No. 14,281, dated 2/15/60:

"1. The surface heat effects observed on the cabin windows were caused by flame impingement rather than by radiated heat.

"2. Time duration of the heat exposure on window No. 18 was between 6 and 10 seconds.

"3. The flame temperature in the region of window No. 18 was approximately 2,000F."

The blue trim paint which runs longitudinally along the left side of the fuselage was blistered in two areas: the lower half of the trim stripe on the galley door and the central part of the stripe aft of fuselage station No. 1117. The paint blistering occurred in narrow bands running parallel to the normal air stream and was most severe in the area under the stabilizer. Paint had flaked off in patches throughout the affected areas. It was noted that no paint blistering occurred in the immediate vicinity of any of the windows, even those showing the most severe heat effects.

Smoke and soot deposits existed in a number of places on the left fuselage surfaces. The white painted area above the windows from fuselage station No. 875 to fuselage station No. 1030 was heavily sooted with streaks running up and back at a 20 degree angle. The soot deposits were heavier in areas between the rings and stringers than they were directly over the ring and stringer stiffeners. A scallop pattern of soot deposit was evident for about 1.5 inches aft of each ring between stringers.

This scallop pattern became progressively more evident toward the rear fuselage section. A streak of black oily substance was deposited from fuselage station No. 570 to the tail cone. This streak, unlike some of the other deposits on the aircraft, could not easily be wiped off and gave the appearance of having been partially baked to the metal. In addition to the 12 inch wide band which started about 42 inches behind the galley door and extended all the way rearward, numerous fine streaks existed both above and below the window line. While most of the streaks were parallel to the flight path, there were minute streaks upward and aft at an approximate angle of 30 degrees.

The tail section consisted of vertical fin and rudder, stabilizer stubs, tail cone (fuselage station No. 1117 and aft), and the lounge floor. The direction of collapse of the right underside of the cone indicated that this section struck the ground while moving rearward, causing damage to the elevator power package, the base of the rudder, and the elevator root sections. The vertical fin was undamaged except for a series of slight linear dents in the leading edge. It was found that the wing planking stiffeners exactly fit these marks.

One other matter should be mentioned. On the ground at Houston and shortly before departure, First Officer Hollowell remarked to a representative of the engine manufacturer (Allison-General Motors), "This aircraft trims up funny." There was no further discussion on the matter nor was it made an item of record in the aircraft's logbook.

As a result of this and another accident six months later to the same model aircraft, the manufacturer instituted a searching reassessment of the aircraft's design. The work was largely analytical but also included wind tunnel testing and flight testing. The program of design re-evaluation was extremely extensive.

Two questionable items in the design of the airplane came to light. One of these was that significant loads imposed on the wing intermediate ribs between the fuselage and outboard nacelles by shell distortion had not been included in the design loads. The other was that the dynamic response of the outboard nacelles in turbulence was different than that used in the original design, with the result that the torsional loading of the wing inboard thereof was increased. In addition, the re-evaluation program disclosed that, with the stiffness of a power plant nacelle installation reduced below normal, propeller "whirl mode" could persist undampened and couple with the wing thus exciting it to failure.

(This is the first of a two-part series dealing with the CAB accident investigation into the destruction of a Braniff Airways Electra at Buffalo, Tex.)

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LETTERS

ANP Decision

I was impressed with your editorial on the ANP (AW May 8, pp. 20-21). Your article pointed out ". . . that the Joint Chiefs of Staff have stated repeatedly since 1959 that there is no specific military requirement for a nuclear-powered aircraft." I believe that old records will also show that there was no specific military requirement for either the first Wright brothers' airplane or the first submarine.

There has been a lot of talk about the missile gap. Could this be because around 1950 there were no specific military requirements or funds for missile development? It looks as if the President of the United States in 1970 will probably call for an investigation into the ANP gap.

W. F. Chana
General Dynamics/Astronautics
Fairchild AFB, Wash.

In addition to the strong editorial by Mr. Robert Hotz, which appeared in your May 8 issue, may I plead with Aviation Week to consider the following suggestion:

Since the one sure method we have as citizens of the U. S. A. is to voice our feelings, I ask you, a powerful force in aviation, to include in your next issue a cut-out page. This cut-out would contain a statement to Mr. McNamara's organization explaining the great need for reappraisal based on a complete scientific study of the ANP program. We, as individuals, given the initial impetus, could sign this statement and mail it to the proper authorities.

An error has been made and we can't stand idly by and watch the results.

S. J. Zigan
Edwards AFB, Calif.

Fighter Concept

With regard to the article on p. 29 of the Apr. 17 issue, concerning the TFX joint fighter concept, it would seem that the committee left a significant omission in its industry tour. If you agree with the conclusions I draw below, it might be a worthwhile subject for editorial comment.

It appears that what is required is a cheap, simple airplane capable of relatively advanced performance and able to mount relatively sophisticated electronic gear. Examining the mission requirements set forth in the article, it appears that an airplane is already well advanced in development which could fulfill the air superiority, interdiction, and reconnaissance missions with very little additional effort—the Northrop N-156.

It would seem that this airplane together with a series of electronic gear modules could be made to serve these missions quite adequately. The fact that the airplane is already in an advanced stage of development would also yield significant advantages in time and expense. In spite of all this, it seems that the airplane has been passed over completely. There may be good reason, but to a disinterested observer the reasons don't seem at all obvious.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

With regard to the ground support mission, the concept presented on p. 160 of the same issue may not be as ridiculous as it seems on the surface. If we come one giant step and a half forward and consider a turboprop version of the proven F-51, it might not appear so ridiculous at all. Some friends and I actually considered a cleaned up modification of this type, a couple of years ago. It didn't make any economic sense as a private venture, but at least we did find that there were engines available that could be adapted to the airframe if one had the time and money.

Again, this would provide the Army with a relatively cheap and quite simple aircraft, capable of operation and maintenance in forward combat areas.

Jim Radcliffe
Mercer Island, Wash.

Yugoslavian DC-6B

Read with interest p. 42 of the May 8 issue, regarding Yugoslavian Airlines.

Caption of top picture presents picture of DC-6B, with marking YU-AFB, listed as only DC-6B that is operated by this line, however, second from top picture lists photo of similar DC-6B, incorrectly listed as Convair 440, with different registration than first one.

With other evidence, the aircraft listed as CV440 has Douglas emblem clearly shown on vertical stabilizer.

Enjoy your magazine greatly, but am particularly interested in Air Transport section.

Carl Warrell
Manager
Jackson Travel Agency, Ltd.
Longview, Tex.

(*The second photo, erroneously labeled as showing a Convair 440, shows Douglas DC-6B YU-AFA also purchased in October, 1958, but which has since been sold by Yugoslavian Airlines to the Yugoslav air force for military transport duty.—Ed.*)

British Candidate

It is with much joy and pride that the people of the United Kingdom have greeted the news of the wonderful space flight of America's first astronaut, Alan Shepard.

This flight has been for us as important to our country's morale and future outlook as that of the United States themselves! As a staunch reader of Aviation Week, I am in no doubt of America's future in space which will most obviously surge ahead now that the barrier has been broken for the paths of future astronauts. We in Britain admire the open-mindedness of the American government and all connected with the scientific exploration of space travel, for this latest mark in America's history shows that America is most probably further ahead in space technology than the Russians, who have shrouded all their development in secrecy, and are obviously holding back the names of German scientists of V-2 fame.

It is unfortunate for me, with such a strong interest in space development, that I live in the British Isles, where a small country like ours cannot afford to engage in such wonderful work, as it would give me great pride to train for future astronautic ventures with the American NASA, thus making the possibility of at least one British astronaut in America's program of the future.

Malcolm F. Pike
Swindon, Wiltshire
England

No-Show Penalty

I can sympathize with the airline managements which want to go slow on no-shows. Customer goodwill is a very important asset to service industries like the airlines, and if they feel that penalizing no-shows will hurt their over-all profits that is their decision under our capitalistic system.

However, we taxpayers are still paying a lot of money to guide and protect any plane in the sky, no matter how many empty seats it carries. There is no reason why Uncle Sam shouldn't get tough with no-shows. The simplest way would be to hold back the 10% tax on any refund, unless a request for refund of the tax were postmarked three days before takeoff.

If the airlines wanted to keep irate no-shows from blaming them, they could include a leaflet with each refund pointing out the expensive services the government provides for each seatholder, whether he is using the seat or not.

Lewis J. Grant, Jr.
Chicago, Ill.

Question of Aid

I have read with interest the letter in AW May 8 (p. 134) written by Capt. Roberto Lim. In one paragraph of Capt. Lim's fine letter he makes reference to the various problems he and his organization are encountering and states ". . . our problem is not studied by the technical people of the United States . . ." After this statement, he then advises that "We, therefore, have found that in spite of ourselves, we must look to other areas for possible solutions to our aviation problems."

In short, then, the U. S. is to assume that if we don't solve the problems of any country which apparently it cannot solve through its own cooperative efforts, then they will seek resolution elsewhere! In the past, and especially in the case of newly organized countries, this kind of reference has meant "you do it, Uncle Sam, or we'll go to the Communists."

Deep in my heart and mind, I refuse to believe that this is what Capt. Lim means, although its wording would imply so.

W. C. Heller
Flourtown, Pa.